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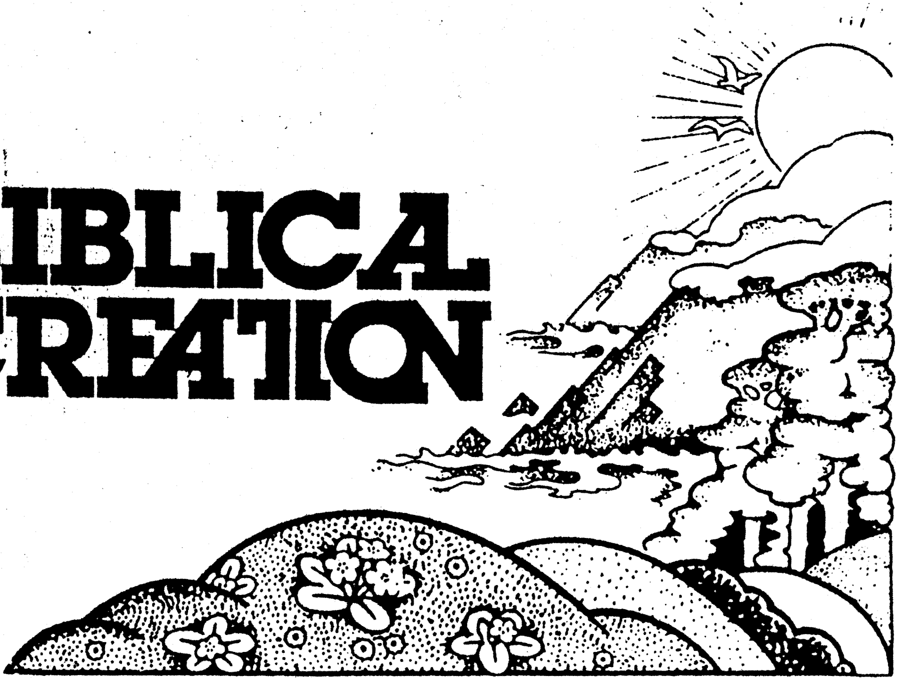
evolved or created?



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PREFACE

'Darwin was far from being an atheist', writes David Attenborough, 'he had, after all, taken a degree in divinity in Cambridge.'[1] This provocative statement, the logic of which is open to challenge, is the nearest approach to religious discussion we find in the book which has been published in association with the Life on Earth BBC television series. Of course, we can hardly fault a modern work on a scientific subject for failing to be something it does not set out to be, a book about religion. As 'a natural history' (its subtitle), interpreted as 'an evolutionary natural history', it is magnificent. It is highly readable, and to one who watched the television version in black and white the splendid colour plates are particularly striking.

We have come to expect that, as 'science' and 'religion' are two separate departments of knowledge (on the understanding of knowledge as like the list of faculties in a modern university), they can have little relation to one another. Yet this is a distinctly modern idea, and Charles Darwin was one of those most responsible for it. It was not at all uncommon, before his day, for leading men of science to preface their published works with prayers or ascriptions of glory to the God Whose creation they believed they were exploring. They saw their scientific work, in examining the glories of the created world, as bringing glory to its Maker. Recently, scholars have come to see the vital part played by deeply religious men in the founding of 'modern science'.[2] It was their Christian faith that gave them motive and guide in exact and disciplined study of the natural world.

Until Darwin's day a chief connexion of religion and natural science was what was known as 'design' in nature.[3] Men believed that, because God had made the natural world, studying the natural world would tell us something about Him. Conversely, because study of the natural world yielded evidence of purpose and design behind it, such study leads us to conclude that it must have been created by a Designer. This 'argument from design' furnished a powerful apologetic weapon for Christianity, and although it is one thing to be convinced in your mind that 'there must be a God', and quite another to be a committed Christian, the consensus belief that God did exist made it very difficult not to believe in God at all. In fact it was part of the theistic framework of understanding in which Darwin grew up. Of course, before his day not all scientists were 'Bible-believing Christians'! But Darwin marks the watershed. Before him, the world of thought, including scientific thought in particular, was fundamentally theistic. After him, it began to become increasingly secular.

Whether or not Darwin's theory of evolution was correct, it made a major contribution to this change; because his theory provided the basis of the world-view and self-understanding that secular and humanist thought required. The theory was a great unifying and explanatory principle. Darwin had developed it to explain the origin of species, but his contemporaries went on to extend it to cover the origin and development of everything. In particular, they applied it to religion, and the religion of the Bible; and although it has often been renounced by scholars of more recent years, 'evolution' has left a lasting mark on the liberal view of the Bible. Yet that was not the most significant result of the theory. By supplying men with an understanding of their origin and the origin and development of their world which no longer gave any place to God, it set their minds free from the rigid framework of theism which had hitherto ruled their interpretation of reality. The old 'argument from design' could be overthrown at a formal level, and the old implicit assumption that God was a necessary hypothesis to account for the present state of things no longer had force. Apparent design and purpose in nature no longer spoke to men of a Creator: it simply showed what 'evolution' had produced - an impersonal, purposeless process which had no final end in view and no guiding hand behind it.

The intellectual world of the mid-Nineteenth Century was ripe for such a release from the trammels of Christian belief, and the attractiveness of this fresh understanding in which God had no place was immense. As we consider the intellectual world a century later, and if we are surprised or concerned by the tenacity with which the theory is held today, we must bear this attractiveness in mind. What alternative is there? The sole possibility - apart from scepticism - is special creation. And special creation involves belief in God, the God of the Bible, the God and Father of the Lord Jesus Christ, the God of the Gospel. Of course, this can hardly be a conscious factor in the thinking of those who believe the theory. And, of course, there are many Christians, whom we acknowledge as brothers and sisters in Christ, who embrace the theory. But, surely, we deceive ourselves if we do not see the deeper significance of this theory. Without it, the modern secular world would be unable either to explain or to understand itself.

Yet we must be fair. That in itself is not an argument against evolution. It is perfectly possible, in principle, that God might create by means of a lengthy process such as that suggested by the evolutionists. The fact that evolution makes it easier to disbelieve could be seen simply as part of the built-in ambiguity of the world which ensures that we are not compelled to believe in God (and we can see the readiness with which some evidence may be interpreted in an evolutionary fashion in this light). At the same time, the evolutionist may face searching questions as even his interpretation of the evidence may reveal evidence of design.[4]

The fundamental question is not a simple one of principle. A god might have created by evolution. The question we face is: Did our God? If we, as Biblical Christians, are to answer that question, we must examine evidence of two sorts: theological, and scientific. We must look at our God's revelation of Himself in Scripture, and we must look at the world He has made. That is what this collection of papers, in a very limited fashion, attempts to do. It deals primarily with scientific questions. Some of the papers are more detailed and technical than others. One looks at the theory of evolution as a whole, and considers its status as a scientific theory. Others look at evidence for and against the theory in different areas. But the theological question is vital too. Granted that a god might have created through evolution, what does the Bible say about our God? Not, of course, that the Bible is a scientific textbook - it is a book about God and His dealings. Yet we believe that it is inspired and therefore reliable, so if it does have anything to say that has a bearing on this matter, we must listen. It might not say anything in one direction or the other. On the other hand, in speaking not about 'science' as such at all, but about God and man and their relationship, if it says something which bears on the matter in hand then we must weigh it carefully. So one paper discusses the question whether God may have worked through evolution.

* * * * * * * * * *

These are profound questions which have exercised some of the greatest of thinkers, and we would not pretend that they could be answered easily. It is our hope that none will think these essays glib or over-confident in their claims. They are offered in dependence on the God Who made heaven and earth and Who sent His Son Jesus Christ to redeem a fallen race, and in the hope that they may help His people as they seek to be faithful to Scripture in their thinking about His world.

Nigel M. de S. Cameron.

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1. Life on Earth, Collins and British Broadcasting Corporation, 1979, p 11. See R.E.D. Clark, Darwin: Before and After, Paternoster, 1948, for some discussion of Darwin's religious life. Viewers of the BBC series The Voyage of Charles Darwin will already know something of the spirit in which Darwin pursued his studies in divinity at Cambridge!

2. E.g., R. Hooykaas, Religion and the Rise of Modern Science, Scottish Academic Press, 1972.

3. The classic statement of this position is of course that of William Paley, in his Natural Theology; or, Evidences of the Existence and Attributes of the Deity Collected from the Appearances of Nature, London, 1802. The most thorough-going outworking of this method is to be found in the eight Bridgewater Treatises published in the 1830's. For a full discussion of the theological/scientific background to Darwin, see C.C. Gillespie, Genesis and Geology, Harper and Row, New York, 1959.

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IS EVOLUTION SCIENTIFIC?

E.H. Andrews

In order to assess evolution as a scientific doctrine we must first understand the nature of scientific theory. Too often evolution is presented as scientific and contrasted with the Biblical revelation which is a matter of personal belief. We challenge this view, contending that evolution is as much a matter of 'faith' or personal belief as is the creationist viewpoint.

THE NATURE OF SCIENTIFIC THEORY

This subject is discussed elsewhere at greater length[1] and will only be summarised here. First of all, as Karl Popper has emphasised, a theory is only scientific if it can in principle be falsified by scientific study. The law of biogenesis, i.e. that life can only be produced by existing living forms and does not arise spontaneously from non-living matter, is a scientific theory in this sense. It is capable of being falsified because a single substantiated instance of spontaneous abiogenesis would suffice to destroy it (or drastically modify it). The theory that the inert gases argon and neon were incapable of chemical combination with other elements was held for many years, but was eventually proved false by the synthesis, under special conditions, of compounds containing some of these atoms. The theory had to be modified to state that under most conditions these gases are inert.

Certain categories of statement, however, are not capable of falsification simply because there is no experiment that can be performed which could conceivably prove them false. The claim that Neanderthal man suffered from rickets can be tested scientifically because that disease leaves its marks on the human skeleton. An apparently similar claim thathe suffered from epilepsy, however, would not be susceptible to proof or disproof and could not therefore be claimed to be a 'scientific' theory, even though epilepsy is just as much a clinical condition as is rickets. The first test, then, of whether a theory is scientific or not lies not in the subject matter of the theory at all, but in the possibility of its proof or disproof.

Thus the claim that life arose once, uniquely, some three thousand million years ago by the chance combination of inorganic molecules is not a scientific theory, even though its subject matter (the chemical combination of molecules) appears highly scientific. If the theory claims the past events to be unique, their non-repetition in any scientific experiments performed today cannot, by definition, falsify the claim! Thus the theory is not falsifiable and hence not scientific. If, inconceivably, a sterile mixture of chemicals was one day observed to yield a life-form spontaneously, even this would not prove that the same thing happened before the dawn of history, nor that it has not occurred many times since the origin of the earth! The most that can be said is that such a past event is more or less likely to have occurred on the grounds of probability. I have suggested elsewhere that the probability of spontaneous abiogenesis is vanishingly small.[2]

The same argument concerning the falsifiability of theories applies to the evolution of species, i.e. to neo-Darwinian evolution. Nothing we can do today is capable of proving that it did not happen. Even in our present situation, where known mechanisms cannot account for or reproduce the evolutionary changes that are alleged to have taken place, it can still be held that natural mechanisms unknown to us were at work. Such unfalsifiable theories are not scientific, but are philosophical speculations based upon a naturalistic world-view which interprets all being as a consequence and expression of process.

Secondly, scientific theory exists on all levels of certitude. At one extreme stands the hypothesis, a unifying concept advanced to account for a set of observed facts. At the other end of the spectrum stands the 'law of nature', which is a theory that has passed the test of verification by experiment, has withstood all attempts to falsify it, and in particular, has been successful in correctly predicting the outcome of specially designed experiments. It is possible for an hypothesis to be transformed by experimental study into a law of nature, although this procedure frequently involves modification of the original idea.

Where does evolution stand in the spectrum of scientific 'truth'? Even if we overlook the fundamental problem of its essentially non-scientific nature outlined above, we find that the theory of evolution is really no more than an hypothesis. No experimental verification has emerged from years of study to substantiate the claim that one kind of creature can be transformed into another by (accelerated) mutation and selection. Indeed, all the evidence that has accumulated points to a limit to the amount of change that can be induced into any viable population. Our increasing understanding of molecular biology and genetics raises problems for evolutionary theory that Darwin and his early champions could not have envisaged.[3] Experimental palaeontology, with its growing wealth of fossil evidence, is only making more apparent the enormous gaps in the fossil record. As more and more material is unearthed it becomes more and more obvious that phenotypes intermediate between the major phyla simply did not exist. The missing ancestral types can only be explained either by abandoning conventional neo-Darwinism (as some biologists have done[4]) or by abandoning uniformitarian geology to explain the missing fossil evidence. Evolution then is at best an hypothesis, and one that current experimental studies have tended to question rather than substantiate.[5]

Thirdly, a given scientific theory is normally valid within bounds; universal theories are the exception rather than the rule. Thus the laws that describe the motion of a cricket ball are not valid for the motion of an electron nor for that of a galaxy. Any attempt to extrapolate a theory into realms far beyond those in which its validity has been scientifically demonstrated is quite unscientific. Yet this kind of extrapdation is continually made in evolutionary thinking. Examples are (a) the doctrine of uniformitarianism in which the quantitative rates at which geological processes are observed today are attributed to the past with no objective justification except that of convenience: and

(b) the use of natural selection to explain the entire past history of the biosphere, when that process has never been observed to produce non-interbreedable populations, let alone entirely new kinds of creature. The evolutionary concept has such vast appeal as a total world-view, that it has been extended to economic, historical, political and religious areas. Such extravagant extrapolations are, of course, self-evidently unscientific, but they deflect our attention from the vast extrapolations implicit in every attempt to interpret the past history of the physical and biological worlds in evolutionary terms.

Fourthly, scientific theories represent interpretations of the facts rather than the facts themselves. This important distinction is frequently overlooked and historical evolution is presented as a fact rather than as a particular interpretation of certain facts, namely the biosphere as observed today and the fossil record. There are alternative interpretations of these facts which are just as respectable scientifically as (some would claim, more so than) the theory of evolution. The fossil record, for instance, is far more consistent with a catastrophic origin than with the gradualism of uniformitarian thinking, since fossils are, demonstrably, not formed in great numbers during slow sedimentation processes such as are typical of our world today. To say that, because there exists a stratified fossil record, then evolution must have occurred, is to confuse the facts of observation with one possible interpretation of those facts, and this is a most unscientific thing to do.

Fifthly, and finally, scientific theories are, at best, only models of reality. Few scientific theories are capable of explaining all the facts of observation, although some have been amazingly successful in this respect. Each accepted theory is recognized as providing the best model, for the time being, of the reality that underlies certain observable phenomena. When a theory is overthrown, or replaced by a superior theory, the true scientist does not get upset. He recognizes that no violence has been done to reality! It is simply that a particular model has been proved inconsistent with reality and has had to be replaced by a superior model. The proponents of evolution, however, frequently fail to behave in such a scientific manner, becoming emotionally involved when arguments are advanced against the theory. To them, the theory has become the reality, a dogma to be defended at all costs. This tendency is frequently found in the writings of evolutionists, is wholly unscientific, and actually hinders the progress of science.[6]

THE INFORMATION CONTENT OF LIVING THINGS.

Having reviewed briefly the way in which evolution fails to pass certain tests when viewed as a scientific theory, we now turn to the main philosophical problem raised by the theory. All life as we know it is based upon the genetic code which is itself inscribed upon the DNA molecule. Every substance, including DNA, possesses what we might call chemical order, which is a direct consequence of the structure of the atoms from which it is formed. This order, for example, determines the bond lengths and angles in molecules and eventually determines the crystallography of solid substances. Here is an order intrinsic to the nature of matter. In DNA, however, and other macromolecules of life (e.g. RNA, proteins) there is superimposed upon this chemical order a higher form of order, namely coded information. A pattern of dots and dashes may exhibit a high degree of order (low entropy) which, however, conveys no meaning. The same dots and dashes, arranged according to a certain convention known as the Morse code, may in contrast convey a highly detailed and intelligible message. When we discuss the origin of order in nature, no problem arises from chemical order and pattern. These are properties intrinsic in the nature of matter, properties which are always present, though not always obvious to the naked eye. (Ice possesses an hexagonal structure but this only becomes obvious in the form of snowflakes. The order is just as present in a block of ice, as X-ray crystallography will demonstrate.) The origin of *coded* order, such as is present in DNA, is quite a different matter, however, since (a) this order is palpably *not* a property of the matter itself, and (b) the information content of such codes cannot have developed from random process or 'noise'.

Evolutionists often argue that *any* event, however improbable, must occur given sufficient time. This concept is totally naive, however, as the following illustration will show. A stainless-steel pin is a very simple human artefact. It contains atoms of iron, carbon and chromium (plus small amounts of other elements), is homogeneous and very simply shaped. Its degree of complexity is minute compared with the simplest life-form known to science. It does, however, have the attribute of bearing elementary 'information', namely it has a sharp end and a blunt end. We use the term 'information' because these aspects of shape cannot arise from the intrinsic properties of the material of which it is composed. They are imposed upon the base material by design. A sphere could occur naturally, as could certain other shapes, but only deliberate tooling or a mould could impart the particular, improbable shape of an ordinary pin. Would an evolutionist insist that somewhere on earth there exists a stainless-steel pin which has arisen by natural process? Yet the probability of such an event is almost infinitely greater than that of the first DNA molecule or protein molecule arising by chance.[10]

Thus the origin of the code, or genetic language, on which all life processes are based represents an enormous problem for those who attribute biogenesis to normal chemical process. Even though it represents a reduction of entropy, it is quite possible for a polymer to arise chemically; but not a *coded* polymer. A simple analogy is that a clay 'tablet' might readily be produced by natural process, but a clay tablet *with writing on it*, if found, would immediately be recognised as the work of an intelligent hand. The creationist's argument is not that systems of greatly reduced entropy could not arise by chance, but that the particular *kind* of entropy reduction represented by the genetic code could not have come about without the participation of intelligence.

The theistic evolutionist, of course, unlike his materialistic colleague, is able to concede that God was providing just such an intelligent 'input' during the development of life. But this admission really undermines the whole evolutionary position because it means that the natural processes of physics and chemistry could not have *themselves* brought about the creation of life. And if God's manipulation of those processes (miracle?) is a condition of creation, how does this differ from the concept of special creation? There is thus a built-in contradiction within theistic evolution. It is a self-inconsistent doctrine. For evolution is no longer evolution once any non-natural agency is introduced as a condition for its operation. The essence of the evolutionary concept is that present natural process can account for the entire geosphere and biosphere, and once this essence is denied, evolution collapses.

It is important here to distinguish between miracle and providence. By miracles we mean actual physical events which could not have happened in the way they did by the operation of natural process. A miracle thus involves the suspension or replacement of physical laws. By providence we signify God's control and use of natural process to achieve his purposes. The theistic evolutionist must specify which of these distinct alternatives he has in mind when he claims that God 'used' or 'overruled' evolution to effect his creative purposes. If he means that God so controlled molecular processes that events took place that otherwise would have occurred only with vanishing probability, he is appealing to the miraculous. This involves the objections mentioned above. If, on the other hand, he means that there was a finite probability of life emerging (and diversifying) by natural process, then God's involvement was a providential one, namely of ensuring that such natural process *did* occur and that, out of a variety of *naturally possible* courses of development, one was chosen that subserved his will. If this is the stance adopted, it makes nonsense of the distinction between God's constant providence (from which surely he has never ceased or rested) and his creative work (which was 'ended' on the seventh day). I frankly cannot see any way out of this dilemma for the theory of theistic evolution. Either the miraculous has to be invoked, in which case the events cannot be ascribed to 'evolution', or else only providence is involved, in which case the Biblical teaching on creation is negated.

SCIENTIFIC RIDDLES UNSOLVED BY EVOLUTION

It is not my purpose in this article to become involved in the detailed scientific arguments against evolution, but for the sake of completeness we here enumerate several of the problems that evolution fails to solve. We are not concerned with matters that can obviously be resolved by dint of further scientific research but rather those stubborn areas of speculation that by their nature are unlikely to yield to physical investigation. What follows is simply an enumeration and not a detailed discussion.

(a) *Chemical evolution or abiogenesis.* The present theory requires that the earth originally possessed a reducing atmosphere, yet there is no proof of this contention and several contra-indications (e.g. the highly oxygenated character of the earth's crustal rocks and the rapid production of oxygen from water vapour in U.V. light with removal of hydrogen from earth's gravity). If life *did* evolve in a reducing atmosphere and if our present oxygen derived only from photosynthesis, there should be fossil evidence of anaerobic, photosynthesising plant life. Yet none exists. The assumption of a reducing atmosphere therefore remains a philosophical presupposition which is unlikely ever to be provable or falsifiable.

(b) *The polymerisation of proteins and/or DNA* would have required either anhydrous conditions or special catalytic molecules. In either case it must remain a matter of speculation whether the appropriate conditions ever existed. The argument that they *must* have existed because *otherwise* life could not have arisen by natural process begs the question completely and underlines the essentially philosophical nature of the theory of chemical evolution. (Philosophy proceeds on the basis of axiom, science on the basis of experiment and observation.)

(c) *The enormous step of forming the first living cell* would have involved processes of molecular self-organisation unknown to science. Furthermore the complex mechanism of cellular reproduction must have evolved in the *brief period of viability* of the first protocell. No way in which this could have occurred is known. Again, acceptance that this occurred by natural process is an act of stupendous faith on the part of the evolutionist.

(d) *Neo-Darwinian evolution.* The adequacy of the proposed mechanisms to account for macro-evolution is doubted by many biologists[4] and remains experimentally unverified. Natural selection, in particular, would expected to produce convergence rather than divergence in populations.[2] In so far as natural selection is claimed to cause divergence, convergence or static situations according to circumstances it is difficult to see how such a non-specific factor could have produced the inexorable 'upward' progress of the biosphere claimed by evolution.

(e) *The fossil record.* The very existence of this record is more consistent with a catastrophic origin[7] than with a uniformitarian one, quite apart from those specific remains which indicate formation by sudden inundations of vast extent.[8] The rates of sedimentation used to date the geological column are low rates characteristic of the deep oceans whereas it is obvious that all but marine fossils were formed on or near land.

The absence of simple and imtermediate forms in the fossil record is a constant embarrassment to evolution. The usual answer is to offer a few homologous series to show progressive evolution within a kind (e.g. the celebrated evolutionary sequence of the horse). This answer is quite unsatisfactory because the selection of fossils to arrange in a homologous series is a subjective matter resting on the evolutionary presuppositions of the researcher, e.g. the assumption that the evolution of the horse involved a gradual *increase* in size.[9] Secondly, the existence of a few homologous series of fossils in no way explains the inter-phyletic gaps; indeed if anything it serves only to emphasise them!

The evolution of one specialised organism from another specialised form is difficult to envisage. Rather we should accept a generalised common ancestor.[2] Such generalised forms, which should form the trunk and main branches of the 'tree of evolution', are notable for their absence.

Although these various comments on the fossil record are 'scientific' the methods adopted by evolutionary theory to circumvent the problems raised are decidedly philosophical. The insistence that the fossil record was formed slowly over thousands of millions of years is based upon the presupposition of uniformitarian geology. The homologous series are constructed as proof of gradual development working on the prior assumption that the remains must be related by evolutionary succession. The gaps are dismissed by the claim that the fossil record is incomplete, a claim based squarely on the assumption that gradual transitions *did* (in spite of the evidence) occur between the major phyla! It is not my purpose here to minimise the difficulties facing research into remotely historical events, but to show that evolution habitually employs circular argument to prove its case *without acknowledging the fact*.

CONCLUSION

We conclude that evolutionary theory fails many of the tests by which its scientific character might have been established. It must therefore be recognised for what it is - a philosophy based upon axiom rather than a science based upon observation. We further conclude that theistic evolution is self-contradictory and fails to solve either the scientific or the philosophical problems of evolution. Finally we have noted some respects in which the evolutionary model of origins is scientifically inadequate.

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CHEMISTRY AND THE ORIGIN OF LIFE:

The quest for a molecular genesis.

David C. Watts

Imagine the solar system viewed from afar. To the gaze of a distant observer four massive planets are visible - and 'debris'. The four planets are Jupiter, Saturn, Uranus and Neptune. They are large bodies, far from the Sun - easily seen through a small telescope somewhat outside our solar system. Spectroscopic analysis of solar radiation, re-emitted from these outer, or Jovian planets shows the presence of the gases hydrogen (H_2), methane (CH_4) and ammonia (NH_3) in their atmospheres; helium (He) and water (H_2O) are also expected. Such spectra are very common in the universe, because of the high cosmic abundance of hydrogen. As the telescope is focussed closer to the sun, some of the 'debris' becomes discernable. The apparent surface features and atmospheric composition of Venus, Earth and Mars are soon detected. The atmospheres of Venus and Mars are composed primarily of carbon dioxide (CO_2); on Venus there are clouds of sulphuric acid (H_2SO_4). But there is something strange about the Earth. There is appreciable oxygen (O_2) in our atmosphere.

As fire and rust attest, oxygen is a reactive gas. It combines with other molecules to form 'oxidised' compounds. Thus water is an oxidised form of hydrogen. By contrast, materials with a large hydrogen content are said to be 'reduced'. The carbon-based 'organic' molecules, of which our bodies are composed, are characteristically reduced. Yet we live in an oxygen atmosphere. In a very real sense earthly organisms are living in a 'poison' gas. Complex mechanisms, however, are present in our bodies which not only *avoid* the debilitating effects of indiscriminate oxidation but also *utilise* oxygen in the metabolism of our food with the associated liberation of energy to power our bodies.

The modern concept of chemical evolution attempts to trace out plausible pathways by which the first living cells may have originated from lifeless materials. The first obstacle confronting this quest for a molecular genesis is the unquestionable fact of the earth's present oxidising atmosphere. How could organic materials, prior to the existence of a living cell, survive the presence of oxygen? It is now generally accepted that they could not survive under such conditions. Primarily for this reason, Chemical Evolutionists *assume* that the earth's primaeval atmosphere lacked molecular oxygen and was instead rich in reduced compounds.

1. THE PRIMAEVAL ATMOSPHERE

The suggestion of a primaeval reducing atmosphere was first made by the Russian biochemist Aleksandr Oparin (b. 1894). In 1924, Oparin published his first book on *The Origin of Life* but it was not widely available in the West. Enlarged and revised editions were published subsequently. View's similar to Oparin's but not as detailed.

and even less convincing, were expressed independently by J.B.S. Haldane in 1929. As we shall see, the idea of a reducing primordial environment on earth is the basis of later experiments on the origin of life.

What scientific evidence is there for the composition of the earth's primaeval atmosphere? Two lines of evidence point to the absence of a primaeval reducing atmosphere.

A. Geological evidence: At the present time the idea of the early atmosphere having contained methane and ammonia is widely questioned by geologists. Most of the geological evidence, however, is controversial and probably inconclusive. The situation is well summarised by Miller and Orgel (1974).

Nevertheless the presence of deposits of haematite, Fe_2O_3 ('red beds') and of magnetite, Fe_3O_4 (banded iron formations) in Precambrian rocks implies that substantial amounts of O_2 were present in the atmosphere. Incidentally, Miller and Orgel consider the converse situation wherein certain lead and uranium ores have been found in a reduced state. They acknowledge that these facts do not prove the presence of a reducing atmosphere, since these minerals may have been deposited under local reducing conditions.

Strong geological evidence, however, is now available in favour of a primaeval oxidising atmosphere. According to the detailed investigations of Dimroth and Kimberley (1976) the distributions of carbon, sulphur, uranium and iron in Precambrian sedimentary rocks are similar to those in more recent (Phanerozoic) sedimentary rocks. These authors conclude that a large reservoir of molecular oxygen was present in the atmosphere in Precambrian times. Moreover they indicate that the current assumption of a reducing atmosphere has hindered the work of prospecting for heavy metal deposits in Precambrian rocks; "the inadequacy of present concepts has become obvious in prospecting for uranium ore in Quebec." (p.1162).

B. The stability of model atmospheres. Both observation and theory indicate that even if the earth did have an atmosphere of hydrogen, methane and ammonia, this was lost before chemical evolution could have got underway. The reasons for this are:-

(i) The stabilities of methane and ammonia depend on the presence of free hydrogen. But the escape rate of hydrogen is such that methane could have persisted only for a fraction of the time normally assumed for chemical evolution (10^9 years). This fraction of time has been put at less than 10% (Rubey, 1955) and as low as 1% (Shimizu, 1976).

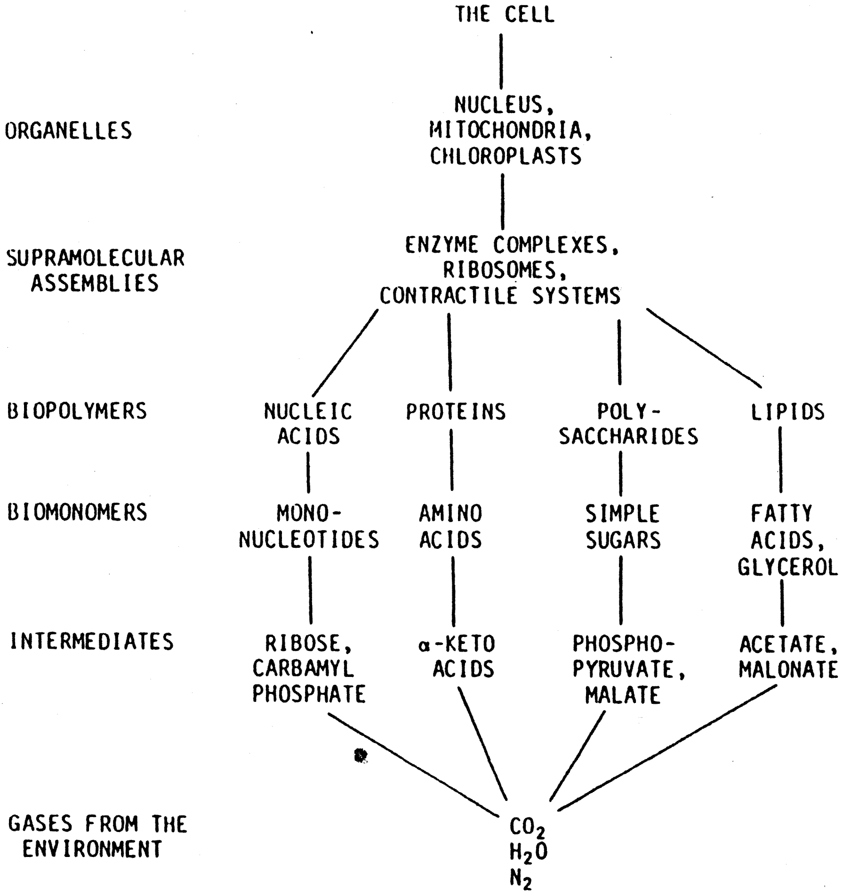
(ii) Ammonia is destroyed by UV radiation of wavelength 225 nm. which is present in sunlight. A terrestrial ammoniacal atmosphere would have been destroyed in 30,000 years (Abelson, 1966).

Geologists now tend to favour the view that the earth's atmosphere was formed by 'out-gassing' of the planet, especially via volcanoes, and that methane and ammonia were absent. The main constituents of volcanic gases are H_2O, CO_2 and N_2. Brinkmann (1969) has calculated that with such a model, the rate of photo-dissociation of water vapour would have been sufficient to generate a highly oxidising atmosphere in the first

1% of 'geological time'. He comments: "It does not seem that early evolution could have proceeded in such an atmosphere".

II. THE STRUCTURAL COMPONENTS OF CELLS.

In order to appreciate the vast complexity of cellular structure it is desirable to consult modern textbooks of Biochemistry and Molecular Biology. It is convenient for our purpose to consider the components of cells in terms of a hierarchy of levels of organisation. As summarised below, the higher levels are the more complex, and each consists of a structured assemblage of components from the level beneath.



In this paper we shall focus upon the structure, and problems of synthesis, of components at two of these levels. These are the biomonomers and the biopolymers (macromolecules). We may note in passing, however, the oft-quoted comment of Green and Goldberger (1967): "the macromolecule-to-cell transition is a jump of fantastic dimensions which lies beyond the range of testable hypothesis".

Two major classes of biopolymer are found in the cell. These are the polynucleotides (e.g. RNA, DNA) and proteins (with folded polypeptide chains of amino acids).

III. SYNTHESIS OF BIOMONOMERS.

The modern phase of attempts at experimental study of chemical evolution dates from the work of Stanley Miller, begun in the 1950's. He circulated a mixture of gases, of assumed primaeval composition, through an electrical discharge. The mixture was hydrogen, methane, ammonia, water and nitrogen. The products were collected in a cold trap. Analysis revealed the presence of amino acids.

When these classic experiments were first reported they were heralded as a tremendous breakthrough. Indeed they are of lasting chemical importance. But 25 years later, the original euphoria having subsided, we may strongly doubt their relevance to events on the primordial earth. Hulett (1969) has documented in some detail the limitations on prebiological synthesis by these means. Firstly, there is the highly dubious relevance of gas mixtures containing methane and ammonia. Absence of these gases results in much lower yields of amino acids. However, secondly, in all the experiments the products could only be obtained because of the cold trap which removed them from the discharge region. Hull (1960) has argued that when the destructive effects of radiation are considered as well as its synthetic effect no significant quantities of even the simplest compounds could have accumulated on the primitive earth. Thirdly, Miller's experiment produces a 1:1 (racemic) mixture of the 'right and left-handed' (D and L) amino acids. These two forms are structurally 'mirror images', like a pair of gloves, yet they are identical in other respects. Only the L variety is found in proteins. A polypeptide chain formed from a mixture of D and L-amino acids will not form stable secondary and tertiary structures which are usual in functional protein molecules. Consequently the hypothesis of chemical evolution requires an efficient mechanism for generating pure L-amino acids. But this is not forthcoming from either Miller's experiments or by any other physico-chemical means.

A further general problem is that some types of biologically important monomers react together in solution to give biologically useless products, e.g. amino acids and carbohydrates. This rules out any idea of a 'primaeval soup' full of biologically important molecules evolving to produce a metabolic system. The components of the system would have to be kept apart until they were ready to be brought together in the final system. Moreover the number of different chemical structures that can be generated from small numbers of atoms of C, N, O, and H is so large that the proportion of any particular structure would be correspondingly small.

When we consider the possible routes to formation of nucleotide biomonomers on the primitive earth, the prospects of success are even more remote. Nucleotides consist of three components. Two of the components comprise a nucleoside, which is made from a sugar molecule to which is attached a purine or pyrimidine base. (These bases are of 5 different types, represented by the initial letters A, G, U, T and C.) The sugar units are also linked to the third component which is a phosphate group.

Miller and Orgel have reviewed the possibilities of chemical evolutionary synthesis of these components. Even the most promising route for obtaining one of the bases (Adenine) requires the formation of concentrated cyanide solutions on the primitive earth, via eutectic freezing at about -10°C. Since the presence of large amounts of salts inhibits this process, frozen raindrops are a suggested milieu. Formation of sugars is proposed from formaldehyde at appreciable concentrations (greater than 0.01 M), but they are unfortunately unstable in aqueous solution and the particular sugar required (ribose) is only obtained in small proportions under optimum conditions.

When it comes to the formation of complete nucleosides and nucleotides, Miller and Orgel (1974) advise us that in their opinion this is "one of the major problems of pre-biotic synthesis," which "has proved to be unexpectedly difficult, so much so that no really satisfactory method has been reported."

IV. SYNTHESIS OF BIOPOLYMERS

The postulated formation of functional biopolymers in a primitive earth environment is a proposal which faces several massive obstacles. Firstly, the monomer molecules must link together (polymerise) to form the chain-like biopolymers, and they must remain polymerised; for the most important macromolecules in living systems are all subject to hydrolysis in aqueous solution. Secondly, the sequences in which the monomer units join together must be a 'meaningful' or functional sequence. This requirement is close to that whereby strings of alphabetic letters are deliberately combined to form meaningful sentences, rather than the meaningless sequences of letters which originate from random striking of typewriter keys.

In the living cell special provision is made whereby these two requirements can be met rapidly and consistently. The polymerisation chemistry requirement is achieved as a result of the favourable balance between the rate of biosynthesis of macromolecules from activated intermediates and the rate of their hydrolysis to non-activated compounds. The meaningful-sequence requirement is met through the presence and preservation for successive generations of cells, of the genetic information stored in the sequence of DNA molecules. Thus the sequences of growing protein chains are determined ultimately by the corresponding sequences of DNA. We will examine briefly whether these two principal requirements could be met in the scenario of a pre-biotic earth. More detailed analyses may be consulted elsewhere (Yockey, 1977; Gish, 1975; Wilder-Smith, 1970).

A. Abiogenic polymerisation. For monomer molecules to react together in aqueous solution to form polymer chains they must first be present in sufficient concentrations. As we have noted, the amino acid solutions produced in Miller's experiments were very dilute. Despite the intensive search for natural mechanisms which will concentrate biomonomers to the required extent, these are still conspicuous by their absence. We may note in passing, however, that this particular quest has diverted attention from the oceans to fresh-water pools and the surfaces of clays and other minerals. While evaporation or freezing processes in such environments may slightly concentrate dissolved molecules, these same environments tend to isolate their contents from interaction at other zones of activity.

Polymerisation reactions of amino acids and of nucleotides are classified as condensation reactions. These have the form:

$$R + M \rightleftharpoons R' + H_2O$$

(R and R' are the growing polymer chain, M is a monomer molecule). Water is liberated by the forward reaction. It must be removed to prevent hydrolysis of the main products in the reverse reaction. Many attempts have been made to carry out these reactions under pre-biotic conditions. This brings us to a most significant diversity of approach among contemporary chemical evolutionists. For the simplest of all dehydrating mechanisms is the elimination of the elements of water from a dry solid by direct heating. This approach to amino acid polymerisation has been advocated - indeed championed - by Dr Sidney W. Fox of the Institute for Molecular and Cellular Evolution in Florida (Fox and Dose, 1977). We have carried out similar experiments to those of Fox in our laboratory. A ground or amorphous mixture of amino acids (principally aspartic and glutamic acids) is heated for 2-5 hours at 180°C (or at 120°C for a week). Boiling 1% salt solution is then added to the hot polymer. After boiling for 30 seconds, the hot clear solution is decanted. Cooling of the resultant solution without agitation gives spherical droplets of polymer with diameters in the range 0.5-7.0 μM. The average molecular weights of the polymers can be as high as 20,000 when glutamic acid is heated with glycine. Fox terms the microspheres 'proteinoids', the implication being that they are analogous to proteins or are even proto-cells. It is here that a great many chemical evolutionists differ with Fox. Miller and Orgel (1974), for example, prefer to label those materials thermal polypeptides. They are typical of a great many scientists who doubt that polypeptides could have been synthesised in large quantities at the surface of the earth by thermal reactions of the kind so far demonstrated. Briefly, these are the problems: (a) Hot springs may have temperatures rising to 150-180°C but they would lead to hydrol is not polymerisation. (b) Beneath the surface of the earth the required temperature may be obtained but the materials would be held in isolation even if amino acids were present to react. (c) At volcanoes the temperature of molten lava is about 1,200°C at which amino acids are pyrolysed completely. Moreover 70% of volcanic gas is water vapour.

Although Fox's polypeptide syntheses require conditions which are too stringent for the pre-biotic earth, and although the resultant polypeptides are in no sense 'living' his work continues to attract notice. He has rightly focussed attention on the need for demonstrable experimental syntheses. At the present time, there is considerable scepticism about Fox's proposals but there is no alternative which commands widespread assent. The difficulties in the way of pre-biotic polynucleotide synthesis, however, are far, far greater than those which relate to the origins of polypeptides. Our own laboratory experience in the synthesis of phosphorous poly-electrolytes, which are comparatively simple analogues of the DNA main chain, leads to a vivid awareness of the need for rigorous control of monomer purity and of reaction conditions. Only with a well-designed apparatus and intelligent experimental planning can one achieve successful productions of these high molecular weight polyelectrolytes.

B. Biopolymer sequences. The importance of biopolymer sequences may be discussed with respect to both protein and DNA molecules. According to the Central Dogma of Molecular Biology, the sequences of the former are determined by the sequences of the latter. Here we will focus attention on protein sequences by means of a particular example, namely the molecule cytochrome C. This is a carrier molecule like haemoglobin, but instead of an oxygen molecule it carries an electron. It is present in all organisms that contain a mitochondrial respiratory chain. It consists of a single polypeptide chain of 104 amino acid residues and a covalently attached heme group. The polypeptide chain is wrapped around the heme. The distribution of charged residues on the surface of the molecule is striking. These are clustered into two positively charged patches with an intervening negatively charged patch. The distribution of charges almost certainly plays a role in the recognition and binding of two other complexes in the electron-transport chain.

According to the sequence hypothesis the significant properties of biologically active proteins are determined by the exact sequence of amino acid residues in the chain. Some of these residues are 'synonymous'. For example, when the sequences of cytochrome C molecules from different organisms are compared it is found that there are variations at some of the sites. So there is a group of 'homologous' protein chains each of which is functionally equivalent. However, the great majority of differences that are present are highly conservative, replacing one amino acid by one that is very similar in composition, volume and electrical polarity. Moreover there are clusters of invariant residues, 27 in all, and one is a long sequence of 11 amino acids which is almost totally unchanging. This sequence must be one of the most vital portions of the molecule. The 3-D structure is also maintained by molecular interactions of various kinds which would be nullified if drastic substitutions of the amino acids were made.

There are about 20 different kinds of amino acids in all protein chains, and these are akin to an 'alphabet' of letters. Like the letters of the English alphabet, these do not occur with exactly the same frequency (or probability) in representative 'texts' of the 'language'. In common with the 'letters' of written languages, amino acids are able to combine in every conceivable combination and permutation. The actual sequences which occur in proteins have been carefully analysed to look for preferred pairings of adjoining amino acids which would be analogous to the preferred letter pairings of English, like 'th', 'gh', 'qu', etc. However, the protein 'texts' show no firm evidence for even this minor kind of inter-symbol interaction. Consequently, there is no basis at all for the idea of functioning sequences having been totally generated through 'internal' (deterministic) preferences. Indeed, were this completely the case, then only one sequence would be possible.

In functional protein sequences, therefore, the pattern of occurrence of amino acids at each site is of great complexity. That is to say, the sequences do not have obvious ordered regularities of structure, as is the case for most synthetic polymer molecules, and simple crystals. A necessary, but not a sufficient condition for the origin of life would be the generation of sequences of the level of complexity exhibited by cytochrome C. Any valid chemical-evolutionary scenario should be able to provide for the selection by natural means of at least one functional sequence of cytochrome C. Selection should be made therefore of any one of the family of functioning cytochrome C molecules.

Taking into account the precise realities of sequence requirement of cytochrome C, Dr Herbert Yockey (1977) has calculated via Information Theory that there are as many as 10^{61} possible members of the family of functioning cytochrome C molecules. However, the total number of possible sequences of 104 sites, with 20 amino acids, is 20^{104} which is 10^{135}. If account is taken for the fact that the residues are not all equally probable this figure is reduced to 10^{130}. Consequently, if chemical evolution were capable of (i) generating abundant amino acids and (ii) enabling them to form long polypeptide chains, we may calculate the fraction of meaningful or functional cytochrome C molecules amongst the total of sequences generated of the same length. This fraction is $10^{61}/10^{130}$, or 10^{-69}. Consequently, any functional sequence would be totally swamped by an astronomical proportion of non-functional sequences.

When we allow for the undoubted presence in a chemical-evolutionary scenario of Left and Right-handed amino acids (L and D optical isomers) then the number of available amino acids would be 39. Therefore the total number of possible sequences for 104 sites is 39^{104} which is 10^{165}; this figure is reduced to 10^{160}, allowing for the different frequencies of amino acids, as before. The fraction of meaningful sequences is now more realistically estimated as $10^{61}/10^{160}$ or 10^{-99}.

Even on the most generous estimates of the time and space and materials available in the universe (see Appendix) the universe is far too small and geological time far too short for even one molecule of cytochrome C to appear by natural means from the primitive milieu. Yet here we are talking, not about a complete living system but about only one protein which is very small indeed.

Some scientists have considered the possibility of the first biopolymer having been a polynucleotide. In particular the Nobel Prize-winner Professor Manfred Eigen has developed the idea of primitive 'hypercycles' (Eigen, 1971; Calder, 1973). These are envisaged as cyclic pathways by means of which a primitive polynucleotide arose by chance and thereafter coded for the first protein. Some brief comments are in order. (i) The sequence requirements for this primaeval polynucleotide are at least as rigorous as those discussed above for cytochrome C. (ii) The proposal begs the question of the origin of the genetic code dictionary for translating from DNA to protein sequences. (iii) The polymer chemistry of nucleotide polymers and monomers is even more problematical than that of polypeptides, as we have noted previously. Consequently, in the words of Yockey (1977a): "the (chemical evolutionary) scenario does not generate even one molecule of the biopolymers of reasonable specificity from which the non-linear processes of evolution considered by Eigen (1971) et al could start." In other words, the the idea of hypercycles can not get off the ground for lack of the original informational ingredients. Once it is recognised that in the cell we have something akin to a fully-orbed linguistic coding, then these theories of a molecular genesis are faced with mountainous problems. We must acknowledge the folly of proposing inadequate causes for observed phenomena. "In the beginning was the Word," is indelibly etched on the protein 'text' and the DNA code.

V. LIFE ON OTHER PLANETS?

Popular belief in the existence of 'humanoid' extra-terrestrial life is a widespread modern mythology, fed largely by science fiction. This belief is not of recent origin. In his poem "On the Nature of Things", the Roman philosopher Lucretius taught the Epicurean view that this world was made by chance collisions of atoms. Moreover, he called upon men to acknowledge that there were other worlds of living beings beyond our own. (During the earlier period of the pre-Socratic Greek philosophers, there was also a definite quest for the archē or basic element from which the cosmos had evolved). In our own day the search for extra-terrestrial life has taken on a 'religious' dimension. The visitor to the Smithsonian Institute in Washington D.C. may visit a dimly lit side room (chapel!) where an image of the talking head of astronomer Carl Sagan is perpetually projected onto a backcloth of the starry heavens. Sagan's message (sermon) is a missionary plea to the U.S. public for a continual supply of billions of dollars to finance the search for extra-terrestrial life via the space programmes.

All this does not go down well with many scientists, however. George Gaylord Simpson of Harvard is typical of those who conclude that the evolution of intelligent life on earth was of so remote a probability that the probability is vanishingly small that the same sequence of events would be copied elsewhere (Simpson, 1964; Sandon, 1966). Certainly there is no evidence of even the most lowly of life forms on any of the extra-terrestrial planets that we know about, namely those in our solar system. Yet so desperate do some secularist scientists become about the problem of origins that they are prepared to sidestep the problems by suggesting directed-panspermia, the intentional colonisation of life on earth by alien beings (Crick and Orgel, 1973; Hoyle and Wickramasinghe, 1978). How bacterial life forms could survive the cosmic irradiation of inter-stellar travel is only one of the questions that arises. How these life forms arose in the first place is the major question.

APPENDIX

'Exploration' of different biopolymer sequences in a finite space-time universe - a representative calculation for cytochrome C.

(1) Consider the maximum number of sequences which might conceivably be present at any given instant if all of the earth's oceans consisted of a concentrated solution of polypeptides with 104 amino acid residues and a molecular mass of 10,000.

A high concentration of 1 $mol.m^{-3}$ would correspond to 6×10^{23} (Avogadro's number) of polypeptide molecules per cubic metre, and a density of 10 $kg.m^{-3}$.

The total number of these molecules in the earth's hydrosphere (volume 1.4×10^{18} m^3) is given by

$$(6 \times 10^{23}) \times (1.4 \times 10^{18}) = 0.8 \times 10^{42}$$

(2) Consider the speculative view of astronomer Harlow Shapley (1958) that there might be 10^8 planets in the universe like our own. Then the total number of biopolymer molecules on all of these planets would be approximately 10^{50} at any instant.

(3) Consider the generous time-span conventionally allotted to chemical evolution. This is 10^9 years, which is approximately 3×10^{16} seconds. Overlooking the realities of polymerisation chemistry, suppose that a new polypeptide sequence was formed every second. Then the total number (N) of sequences ever formed in all of the available space and time is

$$10^{50} \times 3 \times 10^{16}. \text{ That is, } 3 \times 10^{66}.$$

(4) The fraction (F) of functioning sequences of cytochrome C that would be present in any large assembly of sequences of 104 amino acid units has been discussed in the text.

With 20 different amino acids, F is $10^{61}/10^{130}$ or 10^{-69}. Allowing for optical isomers, however, F is 10^{-99}.

The statistically expected number (n) of functioning sequences ever formed is given by F x N. As shown above N is 3×10^{66}.

Consequently, n is $10^{-69} \times (3 \times 10^{66})$ or 3×10^{-3} (i.e. 0.003). Allowing for isomers, n is 3×10^{-33}. In both cases, n is less than one.

(5) Conclusion. According to these generous estimates based upon the proven statistical laws of molecular proportions, not even one functioning cytochrome C sequence will form by natural means in the universe throughout the geological time period.

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GENES, GENESIS AND EVOLUTION:

The limits of natural selection*

Sylvia Baker

It is often claimed that much evidence for evolution has come from the study of genetics. Is this really the case? Or do the findings of this science in fact support the teachings of Genesis?

WHAT DOES GENESIS TEACH ABOUT GENETICS?

"Then God said, 'Let the land produce vegetation: seed-bearing plants and trees on the land that bear fruit with seed in it, according to their various kinds.' And it was so.... And God saw that it was good." (Gen. 1:11-12, N.I.V.) This happened on the third day of the creation week. The fifth and sixth days saw the creation of animals and man. We are told that the great creatures of the sea and every living and moving thing with which the water teems were created according to their kind. Similarly, every winged bird, livestock, creatures that move along the ground and wild animals were each created according to their kind. Each time it is emphasised that "God saw that it was good".

Thus, Genesis teaches the instantaneous creation of the genetic code. It came into being by the design of God. God stresses that the animals and plants that he had created were good. There is no suggestion that they needed any improving upon. Since the genetic code of the various creatures was originally perfect, any change in it would probably be a change for the worse.

Genesis stresses that animals and plants were originally created in certain definite groupings, "according to their kinds". It would be expected from this that there would be definite limits to interbreeding experiments.

WHAT DOES EVOLUTION TEACH ABOUT GENETICS?

The basic concept behind evolution teaches that complex creatures have arisen by a chance process from simple ones and ultimately from non-living material. This idea did not originate with Darwin. Darwin's contribution was the suggestion that evolution had occurred by the process of natural selection. It is most important for us to realise that these two concepts, "evolution" and "natural selection", are not the same thing. Darwin used one to support the other and the two very often become entangled in our minds. We must disentangle them! We will never succeed in understanding what the creation/evolution debate is all about until we realise that natural selection is not the same thing as evolution. There is evidence that natural selection occurs under certain circumstances. There is no compelling evidence that evolution occurs

* A glossary of technical terms will be found at the end of this paper.

under any circumstances. There is no conflict between the concept of natural selection and that of the creation of kinds as described in Genesis. There is total conflict between the idea of evolution and the idea of created kinds.

The concept of natural selection is very well illustrated by the famous case of the peppered moth. In the 1860's, this moth was pale in colour, although a rare dark form was known to exist. During the next 100 years, the dark form became more and more common until eventually the light form was rare. The reason for the change is that the dark form had been at a disadvantage originally, as it showed up clearly against the bark of trees and was therefore easy prey for predators. The light form was not easily seen and therefore escaped from the predators. With the industrial revolution, however, the trees became blackened by soot and the siuation was reversed. The pale form was now conspicuous to predators, while the dark form escaped.

Figure 1. THE RATIO OF BLACK TO WHITE PEPPER MOTHS.

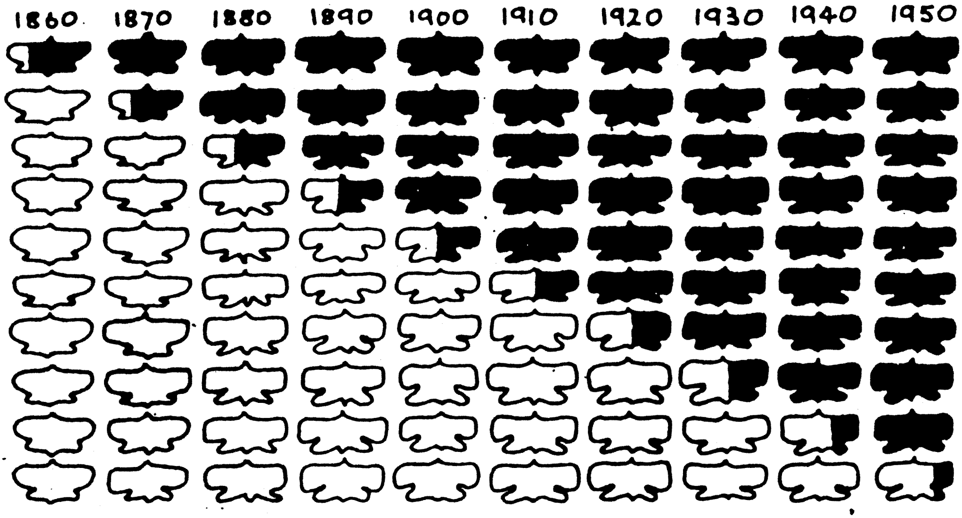


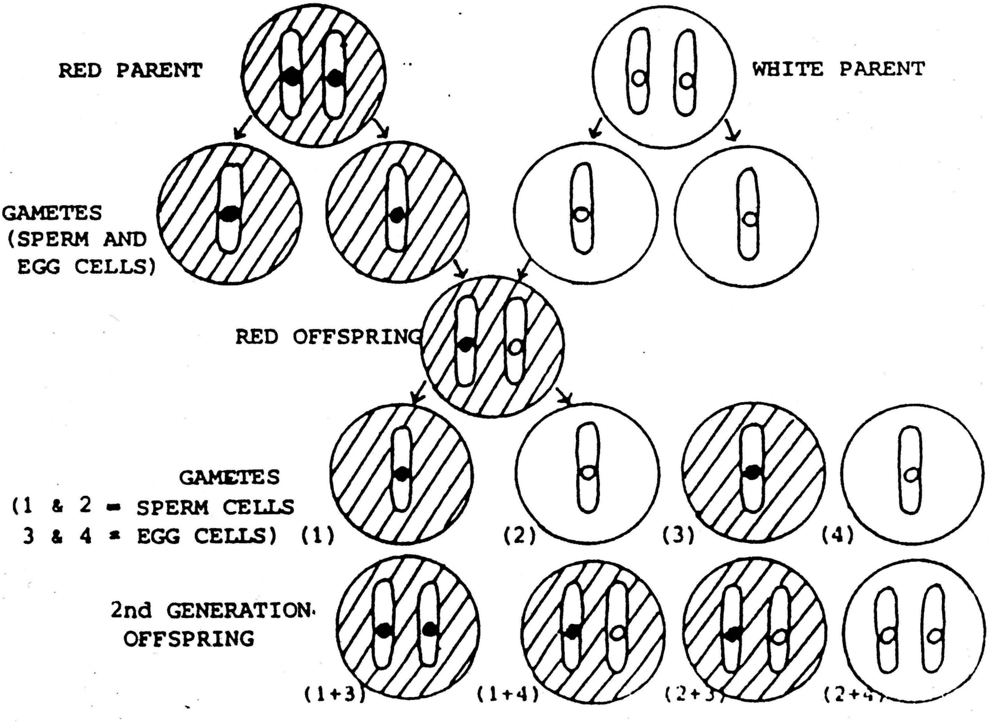
Figure 1 illustrates how,in less than a hundred years, natural selection had caused the population of moths to change from predominantly light-coloured to predominantly dark-coloured.

Having become convinced that natural selection occurs, through his observation of the tortoises and finches of the Galapagos Islands, Darwin then extrapolated the idea to the whole process of evolution. He said that this was the means by which one type of animal had evolved into another. Darwin had also observed that the young always differ in many small ways from their parents. He assumed that these differences had somehow been acquired and that they could be passed on to later generations. His understanding of genetics did not really go much further than that. It was essential that the young of any species should be able to acquire characteristics that their parents had not possessed, otherwise there would be no new material for natural selection to operate upon. For reasons that will be explained later, the modern view of how evolution operates differs considerably from that of Darwin. Today it is assumed that new characteristics are acquired by the process of gene mutation. Thus, modern evolutionary theory requires that genes should be able to change to new, more complex forms; natural selection is then assumed to operate by selecting those new genes which are favourable to the organism and discarding others.

WHAT DO THE GENES THEMSELVES TEACH?

The science of Genetics really began over 100 years ago. It was then that Gregor Mendel performed his experiments with peas and came to an understanding of how characteristics such as the colour of the flower were passed on from one generation to the next. Figure 2 illustrates what is happening at the level of the gene when crosses are performed between plants with different coloured flowers. Mendel assumed that the factor governing flower colour could exist in one of two forms, one giving rise to red flowers and the other to white. The offspring of the original cross of red-flowered plants with white were all red-flowered, although they did in fact possess both a gene for red-flower and a gene for white. Mendel concluded that the red gene must be dominant to the white, so that any plant that possessed them both would be red. When these red plants were bred with each other, it was possible for two white genes to come together and so give offspring that were white. The chance that the offspring would receive at least one red gene is 3:1 as the diagram shows.

Figure 2. MENDEL'S EXPERIMENT CROSSING RED AND WHITE FLOWERED PEA PLANTS.



Mendel's work constituted a real breakthrough in the understanding of inheritance. As such, it should have been received by the scientific community with great excitement and acclaim. In fact, Mendel's findings, although they were certainly known about, were totally ignored until long after his death. How could this possibly have happened? The explanation is that Mendel's results contradicted Darwin's theory of evolution by means of natural selection. The scientific world at that time had almost wholly gone over to Darwin's position, and if Mendel was right, Darwin was wrong. Mendel's work showed that when a new characteristic appeared, it was simply that a gene which had always been present in that species was now able to express itself. Nothing new had been acquired. Evolution could not proceed. Mendel's discoveries did not conflict with the idea of natural selection. They conflicted with the idea that evolution could proceed by this, or any other, means. They led, as one evolutionist put it, "back to creationism".[1]

The findings of experimental genetics, then, presented a very real problem to Darwin's evolutionary theory. Alfred Russel Wallace, a close friend of Darwin, said "On the general relation of Mendelism to evolution, I have come to a very definite conclusion. That is, that it is really antagonistic to evolution".[2] Professor Caullery, who had the Chair of Evolution at the University of Paris in the early part of the 20th century, said "The data of Mendelism embarrass us very considerably".[3] The famous British biologist Bateson is quoted as having said that Darwin would never have written "Origin of Species" if he had known Mendel's work.[4] The day was saved for the evolutionists by Hugo de Vries. He suggested that it was by the process of mutation that new species originated. The term "mutation" is used today to refer to any alteration of the genetic material. It is believed that the processes of mutation and natural selection work together to bring about the evolution of new species. What is the evidence to support this view?

Mutations certainly do occur. There is no argument between creationists and evolutionists about that. However, the two schools of thought would make very different predictions about the effects of mutations. Creationists believe that the genetic structure of an animal or plant was originally designed by God to be perfect. Therefore any changes that may occur in it would probably be for the worse or, at the very best, neutral. It would not be possible for a chance mutation to improve on God's perfect design. Evolutionists, on the other hand, require that some mutations should benefit the organism and cause it to acquire new characteristics. The evidence accumulated by 70 years of intensive research shows that mutant forms are almost invariably weaker than the wild-type. There is no evidence whatever that mutations can cause an organism to acquire new characteristics which are of overall benefit to the organism. Some mutant forms may seem to be more viable under specific conditions. For example, when bacteria are treated with antibiotics, resistant strains emerge. However, these resistant strains have a decreased viability under normal conditions and when the antibiotic is withdrawn, the population soon reverts to the normal type. Thus, there is no example here of any sort of permanent evolution.

An example that is often quoted from human genetics is the mutation to the "sickle-cell" form of haemoglobin. Allele A gives normal adult haemoglobin while allele S gives sickle-cell haemoglobin. If the mutant form of the gene is allowed to express itself fully in the homozygote SS, the haemoglobin is so abnormal that the person dies from severe anaemia. However, in the heterozygote AS, the red blood cells show a tendency to form the abnormal sickle shape under certain conditions but there are no anaemic symptoms. The haemoglobin of these individuals consists of about equal proportions of normal haemoglobin and sickle-cell haemoglobin. It has been found that the heterozygote (AS) has increased resistance to malaria compared with normal AA individuals. This is often quoted as an instance of a mutation which confers an advantage on the organism. However, if common sense is used to consider what has actually happened, it will soon be obvious that no advance has been made at a genetic level. The mutant allele, S, is incapable of producing normal haemoglobin. It is a damaged, malfunctioning gene which, if allowed to express itself fully, will lead to the death of the individual. How can this be regarded as any sort of evolutionary advance? If evolution is to proceed, additional information must be added to the genetic code; in this case, information has been destroyed.

Thus, the evidence from genetics is in favour of the first prediction that a creationist would make - that a mutation, a change in the structure of the genetic code, would almost always be detrimental to the organism. The second prediction, that definite limits should exist to inter-breeding experiments, is also fully supported by the evidence.[5] While we cannot be sure exactly what was meant by the word "kind", it clearly refers to a definite grouping. We would expect cross-breeding to be possible between varieties within the kind, but not between members of different kinds. Domestic dogs, jackals, wolves and coyotes are capable of cross-breeding and therefore presumably are all members of what might be termed the "dog" kind. The term "kind" should not be confused with "species", especially as it is virtually impossible to define a species.

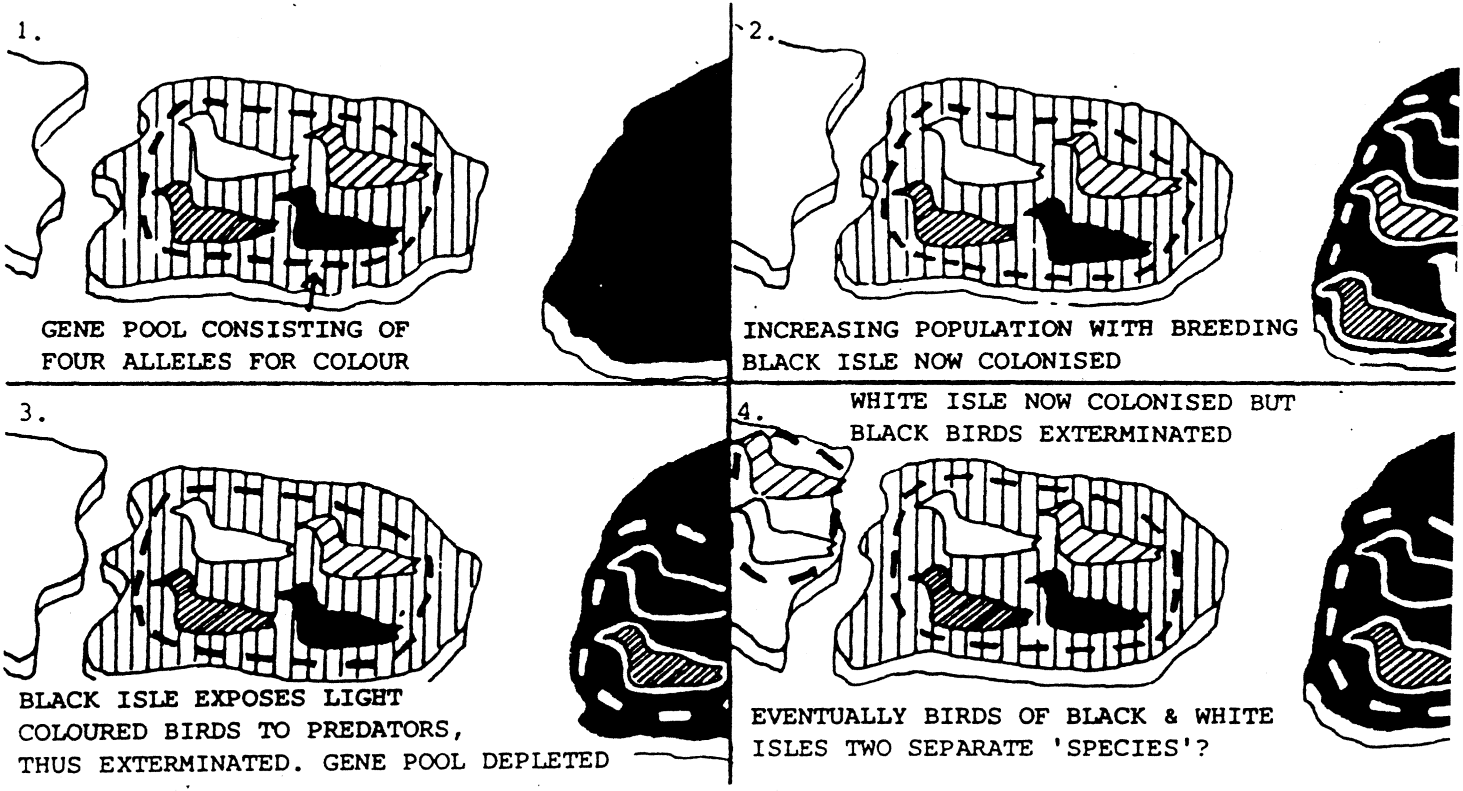
THE LIMITS OF NATURAL SELECTION.

What then are the limits of natural selection? Can it really lead to the formation of more and more complex creatures? I would suggest that the answer is "No" and that rather, as the late Professor Duyvene de Wit pointed out, the process leads, in the end, to genetic death. Figure 3 illustrates a theoretical case of natural selection and follows it through to its logical conclusion.

A hypothetical population of sea-birds can exist in one of several different colours. As the population increases, some birds colonise a neighbouring island which is dark in colour. The white and pale-grey birds on this island are easily seen by predators and are destroyed. The dark-coloured birds cannot be seen and so survive. Gradually a race of dark birds develops as all the light ones die out. A similar process occurs on another nearby island, except that this time the island is light-coloured so that the race of birds that develops is light. Thus, by natural selection, two races of birds have developed from the original population. Eventually these might be considered new species.

What has actually occurred at the genetic level? In the original population, alleles existed for black, dark-grey, light-grey and white colour. On the black island this became depleted to black and dark-grey

FIGURE 3: AN EXAMPLE OF NATURAL SELECTION ACTING UPON A 'KIND' e.g. A SEABIRD



1. GENE POOL CONSISTING OF FOUR ALLELES FOR COLOUR

2. INCREASING POPULATION WITH BREEDING BLACK ISLE NOW COLONISED

3. BLACK ISLE EXPOSES LIGHT COLOURED BIRDS TO PREDATORS, THUS EXTERMINATED. GENE POOL DEPLETED

4. WHITE ISLE NOW COLONISED BUT BLACK BIRDS EXTERMINATED

EVENTUALLY BIRDS OF BLACK & WHITE ISLES TWO SEPARATE 'SPECIES'?

alleles only since the light-grey and white had been lost through the death of the light-coloured birds. Natural selection has thus made the gene pool poorer. There are fewer forms of the gene present, not more as the theory of evolution would require. Since the new population of dark birds is genetically poorer, it is more prone to extinction. A slight change in the environment, such as the island becoming lighter, would enable the race to be wiped out by predators. Such a process operating on a large scale would lead to the extinction of many species. History demonstrates that such extinctions have occurred.

Thus, natural selection leads to new varieties of creatures which are much poorer genetically than the earlier population from which they developed. This suggests that groups of animals must once have existed possessing a rich variety in their characteristics from which have developed the more specialised types that we have today. So the process of natural selection proceeds in the wrong direction for evolutionary theory, but accords very well with Genesis when it says, "In the beginning God created....them according to their kinds".

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GLOSSARY OF TECHNICAL TERMS

Allele.	One of a pair of genes for contrasting traits.
Gene.	Segment of a chromosome that carries a unit of genetic information and controls hereditary characteristics.
Genetics.	The science of heredity.
Gene pool.	The total number of genes possessed by a population.
Haemoglobin.	Oxygen-carrying red-pigmented protein in blood cells.
Heterozygote.	An organism in which the paired genes for a particular trait are different.
Homozygote.	An organism in which the paired genes for a particular trait are identical.

WHAT DO THE FOSSILS PROVE?

A new look at old creatures

K.R. Stokes

This paper looks at the fossil record and describes the information it can legitimately give in support, or otherwise, of the Theory of Evolution. The various attempts to explain the absence of intermediate forms are considered, and Special Creation is proposed as the most satisfactory explanation of animal forms both living and extinct.

INTRODUCTION

Why is so much fuss made about animals that died millions of years ago? The answer to this question is to be found in most text-books of the Natural Sciences. For, in seeking to defend the Theory of Evolution, its protagonists make much of the evidence (often incorrectly labelled 'proof'), believing it to support their contentions. Almost without exception, the fossil evidence is held to be the most important. For example, "No line of evidence more forcefully and clearly supports the fundamental postulate of evolution, descent with accumulative modifications, than that furnished by fossils."[1] In Aids to Zoology, Messrs Lister and Lister include a chapter on evolution in which they list sources of evidence for evolution. At the top of their list, and most comprehensively dealt with, is the evidence from palaeontology (the study of fossils).

The purpose of this paper is to reconsider the fossil evidence regarded by most, if not all, as the foundation of the Theory of Evolution, with a view to evaluating the confidence placed in it.

WHAT IS A FOSSIL?

The word fossil comes from the Latin fossilis, something dug up. A fossil is evidence of an animal or plant that once lived. There are three main types of fossils:

1. Actual remains, viz, where the remains of an organism have been enclosed in a preservative, so that the organic structure has remained practically unchanged. E.g. hairy mammoths refrigerated in Arctic ice, the flesh of which, when thawed, is still edible by dogs.
2. Petrified fossils. Here the organic material of the dead plant or animal has been replaced, molecule by molecule, by other material such as calcite, pyrites, or dolomite. E.g. Ammonites preserved in pyrites.
3. Casts and impressions. In these types of fossils the organic material of the plant or animal has decomposed, but has left an impression in the plastic material which surrounded it. This impression is then filled by mineral deposits in much the same way as a plaster cast is made by filling a mould. E.g. what appear to be dinosaur and human footprints preserved in the Paluxy River bed, Texas.

THE LIMITATIONS OF THE FOSSIL RECORD

Consideration of the limitations of the fossil evidence must be made before it can be used to support a theory. The nature of the fossil record is a reflection of the imperfection of the geological record. Chapter IX of Darwin's The Origin of Species[3] is entirely given over to a discussion of the unsatisfactory nature of the geological record in general and the fossil evidence in particular. The imperfections of the fossil record must limit the conclusions reached.

One of the more important limitations is that the greater part of the fossil record is restricted to a limited section of the animal kingdom, namely the marine invertebrates. The evidence relating to the remainder of the animal kingdom is poor indeed. This is especially true for the remains of vertebrates, animals with backbones (which include man and the primates). A natural consequence of this is that deductions made from the vertebrate fossils ought to be far more guarded and tentative than those made from the more numerous invertebrate fossils. Sadly the reverse is often the case, as is admitted by Prof. Wilson D. Wallis in Presuppositions in Anthropological Interpretations. "The less information we possess by reason of the scarcity of the remains, the more sweeping can be our generalisations."

Another limitation upon the fossil evidence is numerical. Only a minute fraction of any animal population is preserved as a fossil. Shrock and Twenhofel[4] suggest that, if all living organisms are considered, not more than one out of a million individuals will ever leave a fossil record. They suggest that this ratio will vary with species, habitat and place of death and burial. Insects live in most lands in numbers reaching astronomic proportions, yet they suggest that probably not more than one in many millions leaves any evidence of its existence. What degree of confidence can be placed in deductions made from such limited samples?

One other limitation concerns the concept of the geological column. The diagrammatic representation of the geological column shown in most textbooks on the Earth Sciences does not exist in the field. The late Dr. Sherlock in A guide to the Geological Column[5] wrote "It is true to say that owing to the imperfection of the geological record, each country shows an incomplete succession of rocks, but somewhere in the world there are found rocks that help to complete the sequence".

WHAT CAN WE LEARN FROM THE FOSSIL RECORD?

Let us now consider the information that any particular fossil yields. When any creature dies, the soft parts of its body decompose leaving only the hard parts behind: e.g., in the case of the Trilobites, the exo-skeleton; and in Man, the internal skeleton. Even though most fossil remains contain only the hard parts of an animal it does not mean that we are unable to learn anything about the animal's soft parts. The amount of such information varies considerably; e.g. the interior of the shell of the common mussel, Mytilus, contains two scars, being the points of attachment of muscles which enabled the two shells to open and close. Near the lower perimeter of the shell can be seen a line which marked the edge of the mantle (part of the animal's viscera or gut). But the exact structure of the gut and the size and shape of various organs cannot be determined from the hard parts.

All palaeontology books are agreed that sediments belonging to the Cambrian system contain the earliest known fossils. (A few fossils have been found within the Pre-Cambrian but their identity is hard to establish. It is true to say that Pre-Cambrian sediments are generally speaking devoid of fossils.) In the Cambrian system, however, we have a very different situation. Most textbooks show the presence of fossils representative of at least seven or eight major animal groups. Others list more than these. Viz:-

Protozoa - single-celled animals.
Porifera - sponges.
Coelenterata - jelly fish, anemones and corals.
Archeocyatha - animals resembling sponges and corals, now extinct.
Brachiopoda - creatures possessing two shells.
Mollusca - e.g., lamellibranchs, snails and squids.
Arthropoda - jointed-leg creatures, such as insects, crustaceans and trilobites.
Echinodermata - spiny-skinned animals, such as starfish, sea urchins and sea lilies.

Two other invertebrate phyla, Chaetognatha (arrow worms) and Annelida (segmented worms) could also be considered if all the Cambrian sediments are included. Some have included vertebrates (phylum Chordata) within the Cambrian.

Contrary to the evolutionist's interpretation, the earliest fossil remains do not indicate a progression from simple to complex animals, but the presence of well-established distinctive animal groups covering a wide range of structural complexity, often in excess of their modern counterparts.[6] Furthermore, the fossil record also shows the sudden appearance of other groups at 'higher' points in the geological column. The origin of insects, for example, is not known, even though they are the most abundant and diverse animals in existence today. Several hundred species appear in the Carboniferous (Pennsylvanian), the diversity of their forms suggesting long antecedent evolution of which there is no trace whatsoever. The testimony of the fossil record is clear. Many different groups of animals are present within the Cambrian without any evidence of their origin or their having evolved to that position. And other animal groups appear suddenly higher in the geological column without the necessary evidence of development from simpler forms.

Textbooks often show a diagram of the Tree of Life.[7] Such diagrams indicate that the trunk and branches of the tree are hypothetical. The impression conveyed to the average reader, however, is that the diagram before them accurately represents the direction along which life has evolved. The truth of the matter is that the trunk and branches have yet to be discovered.

It may be said in conclusion that in contrast to marine invertebrates, information concerning vertebrates and other life forms accessible from the fossil record is comparatively rare. For each fossil preserved, millions have been destroyed. Of those that are preserved, the greater part of the information they yield concerns only their hard parts.

WHAT CANNOT BE LEARNED FROM THE FOSSIL RECORD

The Theory of Evolution states that all life that we see today has originated from single-celled organisms which themselves arose from lifeless chemicals supposedly formed by the action of lightning upon the primitive atmosphere.

If this were so, then one would naturally expect to find not only the remains of the various phyla which comprise the animal kingdom, but also the intermediate forms or links between these distinctive groupings. The intermediate forms so vital to establishing a credible theory are not to be found. Darwin acknowledged that the silence of the fossil record with regard to intermediate forms posed a serious threat to his theory.

It needs to be stated clearly that the Theory of Evolution is here seen to be weakest where it claims most. There is evidence (not proof) to suggest that within certain groups of animals variation may have occurred over a period of time. Such evidence, limited though it is to variation within groups, is unfortunately often quoted to support the theory in its most general terms i.e., to support variation between groups. A case in point is the 'evolution' of the Ammonites as suggested by the increasing complexity of the suture lines. The suture lines mark the contact between the internal body chambers and the outside of the shell. In the mid-Devonian to Permian periods the suture lines are seen to be uncomplicated, but in the Cretaceous period they appear far more complex.

Such evidence is solely concerned with variation within a particular group with time. It has nothing to say on the question of the transition of animals from one group to another. It is this transition that is at the heart of the theory, and yet it is this irrelevant Ammonite 'evidence' that is used to support it. Many textbooks recognise that the fossil record does not demonstrate the gradual progression of evolution through intermediate forms. However, instead of reconsidering this almost universally accepted interpretation of fossil evidence, and looking for a more satisfactory alternative, greater efforts have been made to explain the absence of intermediate forms.

Several such attempts have been made. A later version of Darwin's theory referred to as the Neo-Darwinian theory proposes that evolution occurred by means of two mechanisms, natural selection and mutation.* This modified theory still requires the presence of intermediate forms between species for credibility, which the fossil evidence does not provide.

Because of the failure of the Neo-Darwinian theory satisfactorily to account for the absence of intermediate forms, another concept, that of

* A mutation is a change in the genetic material of an organism. This change confers characteristics upon the organism that it would not ordinarily possess. These new characteristics usually put the organism at a disadvantage.

'saltation', was introduced. This theory suggests that there are two types of mutation, small ones or micro-mutations, as observed by geneticists, and larger mutations or mega-mutations. The latter, it is suggested, produce large jumps in evolution sufficient for the formation of an entirely new creature. These large evolutionary jumps would help explain the lack of intermediate forms. It is said that they do not appear in the fossil record because they never existed.

This theory has little acceptance at present. Many scientists remain unconvinced that mega-mutations could account for the complex anatomical and physiological adaptations that would have to evolve simultaneously in order to make running and flying possible. Furthermore, saltation, like other theories, cannot be verified.

Another more widely accepted attempt to explain the absence of intermediate forms has been popularised by the palaeontologists Eldredge and Gould.[8] Their model, referred to as 'punctuated equilibria', applies the principles of biology to the data from palaeontology. According to this model, a small number of individuals of a species A became separated from the parent population by a natural barrier. The small separated population evolved into a new species B through the processes of natural selection and mutation. Because the two populations are separated from each other, different mutations and pressures of natural selection would occur within the two populations. Furthermore, the rate of evolution in the isolated population is said to be more rapid than in the parent population. Over a period of time a new species B is formed in the isolated population. The natural barrier separating the two populations is removed and the new species B returns to join the parent population comprising species A. The fossil record following the return of the isolated population to the parent population would contain two distinct species A and B but no intermediate forms.

Objections to this model as it stands are:

1. Its origin is based upon the presupposition that intermediate forms must have existed and thus begs the question.
2. It is difficult to see how this model would account for anything other than minor changes between species. It does not substantiate the contention that evolution between groups has occurred. It merely offers an explanation for the absence of intermediate forms between very closely related fossil species.
3. It is dependent upon the assumption that the isolated population left an insignificant number of individuals behind in the fossil record. It is further dependent upon the assumption that this was true of every isolated population involving what must amount to many hundreds of generations.
4. Punctuated equilibria is dependent upon a set of events which must be repeated in the correct sequence at the right time. *Viz*, the separation of the isolated population; the appearance of the natural barrier; a favourable isolated environment; rapid evolution of the isolated population; disappearance of the natural barrier after an adequate period of time, i.e. long enough for a distinct species to form; and, finally, the preservation of the parent population.
5. There is a conflict between population genetics and palaeontology. Population geneticists are unable to see evolution 'in action' today

because it happens so slowly. Punctuated equilibria on the other hand suggests that evolution cannot be observed in the fossil record because of the rapid evolution of isolated populations. Geneticists argue that evolution cannot be watched today because it proceeds too slowly. Palaeontologists are arguing that evolution cannot be observed in the past because it occurred too quickly. If evolution cannot be observed either now or in the past, an alternative explanation for the origin of the animal and plant kingdoms must be sought.

SPECIAL CREATION - AN ALTERNATIVE TO EVOLUTION

G.A. Kerkut[9] mentions the difficulties encountered whilst attempting to make students consider an alternative to evolution. Creation has been dismissed as an alternative because it necessitates the introduction of God into the debate. Darwin's views on gradualness as the 'pathway to evolution' were formed partly as a reaction against a theological opinion encountered in his early life. Suddenness, in particular the suddenness with which the teachings of Christ gained acceptance, was used by Sumner as a proof of the Deity of Christ. Later, when Darwin became an atheist, suddenness always suggested something supernatural, whereas gradualness was natural. His commitment to gradualness was a positive reaction against any possibility of seeming to include the supernatural within his thinking.

The various developments within evolutionary theory, viz, Neo-Darwinianism, Saltation and Punctuated Equilibria, do not satisfactorily explain the fossil record or the plant and animal world as we see it today.

Kerkut argues convincingly that the fossil record suggests a polyphyletic origin to life. That is, all life has not evolved from a single-celled creature, but from several different ancestral forms corresponding in general terms to the major phyla or animal groups. This suggestion is not far from the teaching of the Bible which Creationists believe most satisfactorily interprets the fossil record.

Creation of plant and animal life as described in the book of Genesis would produce a fossil record demonstrating the following characteristics:
1. The sudden appearance in the fossil record of living organisms with no indication that they had evolved from simpler forms of life. This is exactly what is found in the Cambrian deposits.
2. The sudden appearance of different forms of life at higher levels in the fossil record following the creation and subsequent death of new 'kinds'. One would not expect to find any intermediate forms between the major kinds and none are found.
3. Variation within the major kinds to give the diversity of life we see today. This variation, however, would not be seen to give rise to new 'kinds'. This too is borne out in the fossil record. There is ample evidence of variation within certain groups of animals, e.g. Ammonites, Lammellibranchs, Graptolites and Trilobites. This variation does not give rise to other kinds; an Ammonite remains an Ammonite.
4. The creation of Man as a special act of God means that no connection could be found with any other form of life. The top of the schematic trees of the development of life always show the uppermost branches, describing the appearance of man, to be broken. These broken branches reveal that no link has been found between Man and his so-called ancestors. No links have been found because there are none to be found.

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HOW YOUNG IS THE EARTH?

an assessment of some dating methods

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In view of the multiplicity and variety of the methods which have been used to determine the age of the earth, this article is not meant to be an exhaustive review but rather a brief survey in which general principles and criticisms of the established methods will be explained. Many of the methods depend on uniformitarian ideas, that is the assumption that the rate at which things happen now have been constant throughout past years. Taking a clock as an analogy, the rate at which the clock measures time is assumed to be constant. As will be seen later in this article, this assumption is by no means valid. For example, it is not necessarily justified to assume that the rate at which sodium chloride passes into the ocean, or the rate of growth of stalagmites or of coral, have been constant throughout the past. Even if such an assumption is made, however, it is still not possible to know how much sodium chloride was present in the ocean originally.

A useful, and much-used, analogy in this respect is that of a lighted candle set in a room. An observer could measure the height of the candle at (say) fifteen-minute intervals and would then be able to calculate the rate of burning. Hence, the time when the candle was lit could be estimated provided that (a) the rate of burning was constant and (b) the original height of the candle was known. If, unknown to the observer, the candle had been lit earlier and had burnt down for an hour before measurement started, then assumption (b) would not be justified and the calculation of time would be quite invalid. Similar criticism can be levelled at all the dating methods used, and this analogy highlights the necessity of knowing the amount of (say) sodium chloride present originally in the ocean. It also indicates that the third requirement for an acceptable dating method is to know the concentration in the ocean at present.

Some of the methods used to determine the age of the earth and solar system are as follows: influx into ocean from rivers of numerous inorganic ions including sodium, potassium, copper, silver, gold, mercury, iron, chloride, sulphate; influx of meteoric dust from space; decay of the magnetic field of the earth. The varied nature of the methods, summarised by A.J. Monty White (1978), is matched only by the variety of the dates obtained which vary from as short a time as 100 years (using the influx of aluminium into the ocean from rivers) to the "generally accepted" date for the earth of some 4.6 thousand million years, using isotopic techniques.

During the twentieth century, several isotopic methods for dating rocks have been devised. Numerous elements such as hydrogen, carbon, iron, potassium, uranium, exist as isotopes, which possess the same number of positively charged protons in the nucleus but differing numbers of uncharged neutrons. For each isotope of the element, the number of

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negatively-charged electrons remains the same and hence the chemical properties are identical. There are two kinds of isotope - stable or non-radioactive, and radioactive. Only the latter type spontaneously decay to other products and, in so doing, emit various kinds of radiation which can be measured. The rate of decay is expressed as the half-life ($T_{½}$) which is characteristic for a particular isotope and varies from less than a second, in some cases, to many millions of years in other cases. If 100 per cent of an isotope is present at a particular time, only 50 per cent will remain after one half-life, the remainder having 'decayed' to other products. After two half-lives have elapsed, only 50 per cent of the remainder (i.e. 25 per cent) will be present, and so on.

Since rocks contain small quantities of radioactive isotopes which were trapped at the time of crystallization, it is possible to date the minerals providing (a) the amount of radiation being emitted (in disintegrations per min.) is determined, (b) the half-life of the isotope concerned is known, (c) the quantity of decay product is measured and (d) the original quantity of isotope is known. This last requirement is impossible to determine and can at best be estimated.

(i) The Uranium-Thorium-Lead Method: This method which was extensively used in the earlier years of the present century, depends on the fact that an isotope of uranium with mass number 238 (238-U) decays first to 234-Thorium, an α-particle being emitted in the process. The latter is a Helium nucleus, with mass number of 4, which reacts with electrons to form Helium. 234-Thorium subsequently decays via a complex sequence of reactions to form 206-Lead with the emission of seven more α-particles and six β-particles; the overall half-life is estimated to be about 4.5 thousand million years. Two other decay series are known which end with the formation of different Lead isotopes, 207-Lead and 209-Lead. The problems associated with the method have been summarized by Slusher (1973) and by White (1978): (a) although it is possible to measure the quantities of uranuim, thorium and lead in the mineral, the original amounts can only be estimated - this criticism applies equally to all the isotopic dating methods; (b) the half-life of 238-Uranium and many other isotopes has been assumed to be constant; but there is considerable evidence reviewed by Emery (1972) to indicate that they can be altered by changes in pressure, temperature, magnetic fields to the extent of some 3 per cent. Incidentally, the work of Gentry (reviewed by Talbott, 1977) on pleochroic halos is also in keeping with the possibility that the half-lives of Uranium and Thorium are not constant (see below); (c) one of the decay products, 206-Lead, may be converted to 207-Lead and 208-Lead by neutron reactions (Cook, 1966). Furthermore, it is quite likely that part of these isotopes may have been original Lead; (d) the Helium being a gas, which is formed during the decay processes, is known to diffuse out of rocks into the earth's atmosphere and, moreover, some Helium could have been present in rocks when they were formed and therefore be entirely independent of formation by radioactive decay from Uranium; (e) Uranium salts are known to be water-soluble and can be readily leached out of granite by weathering processes - this would indicate that the decay of uranium isotopes had proceeded for much longer times than would in fact be the case.

In view of these criticisms and unjustified assumptions, it is not surprising that the method gives highly discrepant values. The example cited by Clementson (1970) is a very telling one - volcanic rock, taken from the Azores, Tristan da Cuhna and from Vesuvius, were dated at values between hundreds of millions and several thousands of million years old but were, in fact, a few hundred years old. White (1978) has summarized other discrepant ages provided by this method.

(ii) The Potassium-Argon method: The isotope of Potassium, 40-Potassium is known to decay with an overall half-life of some 1.3 thousand million years to 40-Calcium (some 89 per cent) and 40-Argon (some 11 per cent). This method, in which the isotope of Argon is measured, is used extensively at the present time for dating rocks. However, there are several serious problems in the method which result in considerable variability in the dates obtained. The problems have been summarized by Slusher (1973) and by White (1978) and are as follows: (a) it is not possible to determine accurately the "branching ratio", that is the proportion of 40-Calcium and the proportion of 40-Argon formed in the reactions; the half-life of 1.3 thousand million years relates to the total decay and it is not possible to calculate accurately the half-life for the 40-Potassium ⟶ 40-Argon reaction; (b) 40-Argon is a gas and can diffuse through rocks, particularly from those deeper in the earth's crust, where the pressure is higher, to those near the surface. As samples of the latter are used for dating determinations, a higher content of 40-Argon would indicate an erroneously long time during which radioactive decay had supposedly occurred;
(c) 40-Potassium is known to be readily leached out of minerals, a fact which would also indicate an erroneously high age; (d) it is also assumed (as with all isotopic dating methods) that when the parent radioelement crystallized in the mineral, no decay products were present. This is certainly not so for 40-Argon because volcanic rocks are known to inherit this isotope from the magma from which the rocks were derived. This results in very high age values for quite youthful volcanic larva flows. A case in point is the 200-year old submarine larvas near Hawaii which were dated as high as 22 million years old (Noble and Naughton, 1968). It is only fair to point out, however, that Funkhouser and Naughton (1968) have explained this discrepancy in some detail. These larvas apparently contain high melting point rock particles with radiogenic argon present in them. Since they did notmelt some 200 years ago when the larva flowed, their radiogenic 'clocks' were not reset at that time and consequently give much older dates. (e) finally the amount of 40-Argon in the earth's atmosphere is some one hundred times too high for all this to have arisen by radioactive decay of 40-Potassium.

(iii) The Rubidium-Strontium Method: This method which utilises the decay of 87-Rubidium into 87-Strontium,has been criticised by Slusher (1973) and will not be further discussed here.

(iv) The 14-Carbon Method: This extensively used method was devised by Libby (1949). The long-lived isotope, 14-Carbon (half-life approximately 5730 years) is made in the upper atmosphere by neutron bombardment of Nitrogen. 14-Carbon then slowly reverts to 14-Nitrogen with the emission of an electron (β-radiation). Since the properties of isotopic Carbon are similar to those of non-radiogenic 12-Carbon, it reacts with Oxygen to form 14-Carbon dioxide, which is assimilated into plants by photosynthesis and ultimately into animals. When an organism dies, the 14-Carbon-labelled compounds remain and the amount of β-radiation being emitted from a sample can be measured. Thus, the age of the sample may be determined, providing that at least six assumptions are made (Slusher, 1973). Three of these will be discussed: (a) that the half-life of 14-Carbon remains constant - this is probably unjustifiable in view of what was said above; (b) that the amount of cosmic radiation and neutron bombardment in the upper atmosphere has remained constant; thus resulting in a constant rate of formation of 14-Carbon, and (c) that the rates of formation and disappearance of 14-Carbon have been in equilibrium. With regard to assumption (b) it is highly unlikely that the amount of cosmic radiation has been constant throughout the past because of the probable existence of a vapour canopy, described in Gen.1:6-8, which contained many feet of water. This concept was suggested on scientific grounds by Korff (1954) and has been argued for cogently in physical and thermodynamic terms by Dillow (1978). Such a water-laden atmosphere would drastically reduce the amount of cosmic radiation and hence the amount of 14-Carbon being produced from atmospheric Nitrogen prior to the Noahic Flood of Gen.7:11. This would reduce to negligible quantities the amounts of 14-Carbon being assimilated into plants and animals at that time (Tyler, 1977) and would result in an apparent age of at least 40,000-50,000 years when the true value would be approximately 6,000 years (White, 1978). Once the vapour canopy collapsed as the water precipitated, the formation of 14-Carbon would again increase. The situation is complicated further by the burning of fossil fuels (e.g. coal and oil), particularly from the time of the Industrial Revolution, which would dilute the 14-Carbon content of the atmosphere; moreover, since 1954, when atomic devices have been tested, releasing neutrons into the atmosphere, the radiocarbon content is known to be increasing once more. Assumption (c) above is also unjustified, as Slusher (1973) has shown that the rate of formation of 14-Carbon at present is some 24 per cent higher than the rate of its decay and, in a recent paper, Tyler (1978) has confirmed this by comparing the 14-Carbon date of archaeological Egyptian samples with the chronologies of ancient Egypt and tree ring dating methods. He has constructed a revised calibration curve for 14-Carbon dates which shows quite close agreement between these and the real age up to some 3,500 years ago. Very great ages, however, indicate a real age of only about 4,000-5,000 years ago. Using the imbalance of 24 per cent between rates of formation and decay of 14-Carbon, Cook (1970) had earlier calculated that the age of the earth's atmosphere is less than 10,000 years.

As indicated earlier, one of the criticisms of all radiometric dating methods is the possibility of variation with time of the half-lives of isotopes by some 3 per cent or more. Changes in electric fields are known to change the half-life of 57-Iron by 3 per cent (Emery, 1972) and pressure affects the half-life of 7-Beryllium (Hensley and Bassett, 1973). The work of Gentry and his collaborators on pleochroic halos (reviewed by Gentry, 1973 and by Talbott, 1977) has provided evidence that the half-lives of isotopes of Uranium and Thorium also vary with time. Pleochroic halos are found in some minerals, especially mica, and consist of concentric dark and light rings with radii between 5 and 20 micrometres. They are known to be formed as a result of the enclosure of minute grains of minerals containing Uranium and Thorium at the time of crystallization of the rock; the subsequent decay of these isotopes results in the emission of α-particles which come to rest and produce distortions of the crystal lattice. These distortions are manifested as discolorations and it is these which can be seen on microscopic examination. The magnitude of the radii of the rings is related, by the Geiger-Nuttall rule, to the half-life of the isotope, so that; if the former vary, then it implies that the half-life also varies. Gentry's work clearly indicates that such is the case for Uranium and Thorium. Of particular interest is the fact that halos for 218-Polonium have been discovered in some micas (Gentry et al, 1974). Since the half-life of this isotope is only 3.08 minutes, it must imply that the mineral crystallized very rapidly after formation, otherwise the isotope would have decayed long before the crystal lattice would have been deformed by α-radiation.

Two other dating methods should be mentioned - those of dendrochronology (tree-ring dating) and of racemisation of amino acids. Dendrochronology will not be discussed in this brief review but has been explained and criticised by Tyler (1978) and by White (1978). The amino acid racemisation method can be explained briefly here if it is remembered that amino acids (except the simplest, glycine) occur as optical isomers. The L-form of aspartic acid, for example (see e.g. Helfman and Bada, 1975; Masters et al, 1977) is spontaneously converted to a small proportion (approximately 10-15 per cent) of the D-form over quite long periods of time, and this process is called 'racemisation' because the 1 to 1 mixture of D- and L-forms is the racemate. It should be noted, however, that complete racemisation never occurs. By estimating the amounts of the two forms of an amino acid present in proteins of once-living animals and plants and knowing the half-life of the racemisation process (3,500 years for L-aspartic acid), it is possible to calculate the age of this sample. As with other methods, there are, however, many problems which can result in discrepant dates. Both temperature and pH are known to alter markedly the rates of racemisation, and, furthermore, it is surprising that the process is never complete if animal and human remains are as old as other methods would appear to indicate. Some of the problems involved have been discussed by Elias (1972).

Summary of evidence for a young earth. During the past two decades, evidence has been accumulating which indicates that, far from being of the order of thousands of millions of years old, the earth and solar system are very young, that is of the order of a few thousand years old.

(a) It will be recalled that, in the Uranium-Thorium-Lead decay series, Helium is formed in rocks, some of which diffuses into the earth's atmosphere, some into the oceans and the rest remains in the rocks. Cook (1966) has calculated how much Helium enters the atmosphere from Uranium decay, how much is lost to space and how much is added to the atmosphere by cosmic radiation. He has obtained a value of less than 12,000 years for the age of the earth, assuming that no Helium was present originally; if there were, the figure must be reduced. This contrasts markedly with the 4.6 thousand million years obtained by the same method if no such allowances are made.

(b) The age of the earth's atmosphere of approximately 10,000 years (Cook, 1970) has already been mentioned above; this value was obtained using the 'non-equilibrium' concept for 14-Carbon in the atmosphere.

(c) Analysis has shown that some 14 million tons of micro-meteoric dust settles on the earth's surface every year (Petterson, 1960); this dust has a high Nickel content and the oceans are known to possess only about 8,000 years worth of this element. If the earth were 4.6 thousand million years old, the layer of dust should be 54 feet high, assuming that it was left undisturbed. This is obviously not the case. Similar evidence indicates the youthfulness of the moon which possesses a thin layer of dust on its surface, a magnetic field (and, hence, a molten core) and moonquakes. If the moon were that old it would have solidified long ago and would not have a large temperature radiance at its surface (see White, 1978) as is the case at present.

(d) The existence of comets is indicative of a young solar system. These are continually undergoing degradation by the effects of the sun and planets, so that the life expectancy of meteors is only about 10,000 years.

(e) The earth is known to possess a magnetic field which is thought to originate in the fluid core (Barnes, 1973). The magnitude of the field is decaying exponentially and, assuming that this rate has not varied, the magnetic moment can be calculated for different times in the past. Very large and exceedingly unlikely values are arrived at even assuming that the earth is 15,000-20,000 years old; a maximum age of about 10,000 years was deduced by Barnes (1973). These methods and others reviewed by White (1978) all give values of the order of a few thousand years for the earth's age and are in keeping with the 6,000 to 6,500 years obtained from the genealogies of Genesis.

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EVANGELICALS AND 'THEISTIC EVOLUTION':

Can we eat our cake and have it?

N.M. de S. Cameron

THE VIEW FROM MARS

If a man from Mars were handed a Bible and an evolutionary textbook, he might be forgiven for concluding that the accounts they present of the origin of man and his world are fundamentally different. For there is little dispute that, whatever may be the case in fact, the Biblical account at the least appears, on the surface, to be quite distinct from the evolutionary account. We can imagine the two laid out, side by side, in diagrammatic form. The one presents man originating on a high plateau of perfection almost at the start of the history of the world. The line of his history then plunges down as the Fall and its ensuing curse take their terrible effect. Not until the call of Abraham, the Exodus from Egypt, and finally the coming of Christ, does the curve gradually begin to crawl back up the page. The evolutionary account is at once simpler and different. The line commences right at the bottom: man's climb has been gradual and constant. And if the time-scale marked off is the history of the world, man will appear only at the right edge of the graph: he is a very recent arrival.

There can be no doubt that some such contrast would present itself immediately to the intelligent visitor from Mars, because the contrast is indeed present. And he need not be a Martian to come to this conclusion. Any man or woman, given intelligence and impartiality, will reach it. Because, whatever belief you may hold about evolution and the Bible, the fact is that they appear to provide very different accounts of how we came to be here. So much is generally admitted, even by those who nonetheless believe that both Biblical and evolutionary accounts may be true. There is an apparent contradiction. The question at issue is not whether they appear to contradict each other, but whether they really do. If it is true that the two pictures may be reconciled, then so much the better. But as they appear to contradict each other, any suggestion that they do not must be carefully weighed. Our Martian visitor - an impartial observer - will need persuasion to be convinced that the apparent contradiction is not a real one. That is the issue, and the reliability of the evolutionary theory and the reliability of the Bible are in the balance. May we conclude that both are reliable? Or must we conclude that only one tells us the truth, and the other is therefore mistaken?

ATTEMPTS AT HARMONY

The history of the past 150 years is littered with attempts to harmonise with the Bible what was at first simply the new geology, and then the new biology - evolution. They may all be gathered under the head of 'theistic evolution', as all accept evolution while believing in a God in some way behind it. At one end of the spectrum we have men like Teilhard de Chardin, who have little interest in the details of the

Biblical account, and yet who are very interested in evolution; and the great bulk of modern Church people whose outlook is theologically 'liberal' and who have a rather low view of the authority of the Bible. At the other we have those who concern us today. They are not simply 'theists' - believers in a God involved in the process of human history - but Christians who hold the Bible in high regard. It is not enough for them that God should be the vital force behind or within evolution. They believe in the God revealed in the Bible, so what the Bible says about God and about the world must correlate with reality. This group includes many conservative Catholics and 'evangelical' Protestants. Although our concern is with Protestant evangelicalism we should remember that this is a problem also for Catholicism, since the Roman Catholic Church remains more closely wedded to dogma, much of it Biblical, than the major Protestant churches, and in that dogma some of the details of the Genesis account have an important place.

Theistic evolutionists today find themselves chiefly concerned with the re-interpretation of the Bible. There have, in the past, been apparent anomalies in the evolutionary picture which have had to be remedied for it to be reconcilable with the Christian religion. For instance, it could not be seen simply as a naturalistic process which ruled out divine involvement altogether. But although there are still scientists and others who see evolution as incompatible with any kind of religion, it is generally recognised that in coming to such a conclusion they are not making a scientific judgement on the basis of scientific evidence, but a religious or philosophical judgement, based on their own religious or philosophical beliefs. Evolution considered as a scientific model of origins does not rule out belief in a God standing behind it, and perhaps occasionally involving Himself in it.

The problem for the reconcilers lies not in science but in the Scriptures, and consequently the major task of the theistic evolutionist is to show that the apparent problems which Scripture presents are only apparent. Let us turn to two key issues and discuss them briefly to see whether the theistic evolutionists have made out their case.

1. Genesis 1 and the 'days' of Creation

A basic assumption of theistic evolutionists, and in this country of the mass of Christian opinion, is that although Genesis 1 may appear to teach the Creation of the world in six days, and although this may appear flatly to contradict the theory of evolution, _in fact_, on closer examination, the problem does not arise.

First of all, it is widely believed that the word given as 'day' in our English versions can mean simply 'a period of time' or 'a long period of time'. We find such an assertion in many popular books on the subject, and by frequent repetition it has almost established itself as truth. In actuality, the Old Testament does not contain any instance of the word _yōm_ being used to mean 'a long period of time' in the sense required. Like any other word, it may be used figuratively; but, of course, the context must require or at least suggest a figurative usage for the normal usage to be set aside - otherwise any statement could be made to mean what the reader might wish. So when, for instance, Canon Victor Pearce, in his book Who was Adam?, writes 'Moses himself speaks of the creation days as being great periods of time in Ps 90', he is grossly misleading.[1] In the New International Version the passage reads like this:

> You turn men back to dust,
> saying, 'Return to dust, O sons of men'.
> For a thousand years in your sight
> are like a day that has just gone by,
> or like a watch in the night.
> You sweep men away in the sleep of death;
> they are like the new grass of the morning -
> though in the morning it springs up new,
> by evening it is dry and withered. (vv 3-6)

The psalmist is speaking of the brevity of human life and its insignificance in God's perspective: a thousand years may roll past, but it is of no more significance to Him than an evening or a night-watch to us; how much less significant are our fleeting lives! The meaning Canon Pearce seeks to draw from this text is simply not there.

The argument that yōm can mean a long period of time is not founded on Old Testament exegesis. The standard Hebrew Lexicon of Brown, Driver and Briggs devotes more than six columns to the word, and while it has many shades of meaning, this is not one of them.[2] It is quite true that in expressions like 'the day of the Lord', 'the day of Midian' and 'the day of blessedness', a '24-hour day' is not in view: but neither is a protracted period of time! They refer to a specific occasion, past or future, not a period of time as such at all.[3] But to argue about the meaning of 'day' in Genesis 1 is not really to argue about theistic evolution at all. Even if it were accepted that the word could mean something other than a '24-hour day' it is difficult to see what advantage would be gained.[4] Even if it could mean one in a series of great periods of time, such as the geological ages, the question remains: would this be compatible with evolution? A century ago this type of harmony was very popular, but its popularity has waned - partly no doubt because it is clear now that the answer to this question is No!

Despite the oft-repeated assertion that there is 'a remarkable degree of correspondence ... between this sequence (sc. in Genesis 1) and the one implied by current science', as a noted evangelical scholar has put it,[5] that correspondence is undermined by several fatal flaws. At a time when such a position was taken more seriously by the outside world than it is today, these flaws were pointed out by a man of the eminence of S.R. Driver, the greatest critical Old Testament scholar of his day in Britain. Driver puts his finger on the discrepancies between the Genesis cosmogony and the evolutionary picture. Let me quote him. He is speaking of the meaning of the word 'day'.

> It is ... conceivable that the writer, in spite of his regular mention of 'evening' and 'morning', may have used the word in a figurative sense, as representing a period, aware indeed that the work of the Creator could not be measured by human standards, but at the same time desirous of artificially accommodating it to the period of the week. Let us, now, at least provisionally, grant this metaphorical use of the term 'day': the following questions will then arise. Do the 'days' of

Genesis correspond with well-defined geological periods? and does the order in which the different living things and the heavenly bodies are stated to have been created agree with the facts of geology and astronomy? To both these questions candour compels the answer, No.[6]

Let us see his objections.

i) In Genesis, vegetation is created two 'days' before animal life; in evolution, they are seen to appear simultaneously.

ii) In Genesis, fish and birds appear together, before land animals; in evolution, the land animals come between the two, and it is from them that the birds evolve.

iii) The sun, moon and stars are created after the earth, in Genesis. As Driver puts it,

> The formation of the heavenly bodies after the earth is inconsistent with the entire conception of the solar system - and, indeed, if we think of the stars, with that of the whole celestial universe - as revealed by science.

In particular, the sun must ante-date the earth. To the suggestion, familiar today as it was to Driver, that on the fourth 'day' the sun, moon and stars were not 'made' but instead 'appeared' and became visible from the earth, he has his answer:

> Hebrew is not such a poverty-stricken language as to have no word expressing the idea of 'appear' (see v.9); and had the writer intended 'appear' it may be safely affirmed that he would have said so.[7]

iv) Finally, Driver comments:

> From the injunction in v.30 it is a legitimate inference that the narrator considered the original condition of animals to be one in which they subsisted solely on vegetable food. This is not merely inconsistent with the structure of many animals (which is such as to require animal food), but is contradicted by the facts of palaeontology, which afford conclusive evidence that animals preyed upon one another long before the date of man's appearance upon the earth.[8]

These are real problems for the man who would harmonise Genesis 1 and evolution. Far from the apparent difficulties melting away in the light of detailed study, fair interpretation of Genesis 1 - even if it allows that a 'day' can be an age -reveals only further problems. We may quote Driver yet again, for even though he is not a Martian his analysis of the problem is unprejudiced and acute. He concludes his discussion,

> Read without prejudice or bias, the narrative of Gen. 1 creates an impression at variance with the facts revealed by science: the efforts at reconciliation which have been reviewed are but different modes of obliterating its characteristic features, and of reading into it a view which it does not express. The harmonistic expedients ... are in reality tantamount to the admission that, understood in the natural sense of the words - and we have no right to impose any other sense upon them - it does not accord with the teachings of science .... it is impossible not to feel that, had he been acquainted with (the) actual past, (the writer) would, while still using language equally simple, equally popular, equally dignified, have expressed himself in different terms, and presented a different picture of the entire process

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And he adds, as we may now add:

> It will ... be now apparent that the admission, granted above, that 'day' might be interpreted as representing a period is of no avail for bringing the narrative into harmony with the teachings of science; and that consequently there is no occasion to understand the word in any but its ordinary sense.[9]

2. Genesis 3 and the Fall

A second widely-held assumption is that chapters 2 and 3 of Genesis, although they may appear to contradict the evolutionary account of man's origins, on closer examination may be readily harmonised with it. One leading British evangelical has expressed himself in this way:

> It seems perfectly possible to reconcile the historicity of Adam with at least some (theistic) evolutionary theory ... To assert the historicity of an original pair who sinned through disobedience is one thing; it is quite another to deny all evolution and to assert the separate and special creation of everything, including both subhuman creatures and Adam's body. The suggestion ... does not seem to me to be against Scripture and therefore impossible that when God made man in His own image, what He did was to stamp His likeness on one of the many 'homonids' which appear to have been living at the time.[10]

Canon Pearce's book, to which we have already referred, adds flesh to the bones of such a theory, with a wealth of data from anthropology and related fields. He contends that the Adam of Genesis 2 was a farmer, one of the first New Stone Age men, of around 12,000 BC.

The principle of these theories is to identify Adam with an individual man at some stage in the ongoing process of evolution. He is thought of as the first Homo, or the first Homo sapiens, or the first man of some period in the history of Homo sapiens. God selects him and reveals Himself to him, and the encounter that results is described in Genesis 2 and 3. The man turns his back on God, loses his innocence, and - in the terms of Christian theology - 'falls'.

We are assured that close study of the Genesis narrative will uphold such a harmony, allowing for the conclusions of modern anthropologists, and so on, while maintaining the authority of Scripture. Now, it is immediately evident that there are certain aspects of the Genesis story which will not fit in with this reconstruction. Adam was not made from the dust of the ground: he evolved. Eve was not made from his side: she, too, was the product of evolution. The impression the narrative gives of the planting of Eden as the immediate aftermath of the creative process of Genesis 1 must be set aside, since a great period of time has elapsed since the world and its constituent parts were made. All this, and a good deal more, we are told, is simply detail. It illustrates and ornaments the truth of what is at the heart of the story, making comprehensible and memorable the kernel of the account.

For the sake of argument, we may accept this case. It has a reasonable ring to it. The ancient Hebrews were fond of narrative tales, and that the bare bones of God's moral encounter with a primitive man should be shrouded in the ornament of an Eastern story is certainly possible.

What, then, is the teaching of the story? What is the truth conveyed in the midst of all this unimportant detail?

A great deal might be said in answer to that question. We shall confine ourselves to one area: the Fall and its effects. For this story is about the entry of sin into the world, and its consequences. The setting provided by Genesis 1 is one of perfection; the world is seven-times good, in the eyes of its Maker. Man comes on the scene, brought into a paradise prepared specially for him. He is commanded not to eat the fruit of a certain tree. He is told that, if he eats it, he will surely die. His wife is tempted to eat it, and she in turn tempts him. He is pursued by God in his shame and guilt, he is tried, he is convicted; and he is sentenced. The ringing tones of the curse apply the threat of death in terrible detail:

> By the sweat of your brow
>   you will eat your food
> until you return to the ground,
>   since from it you were taken;
> for dust you are,
>   and to dust you will return. (3:19)

Adam will die - and so will his posterity - because of sin.

Now, that is no eccentric interpretation of the central thrust of Genesis 2 and 3. It is the New Testament's own interpretation, and, as N.P. Williams points out in his classic work on the subject, as a result it is 'the interpretation' of 'historical Christianity' that there is a 'casual connexion between Adam's sin and the fact of human liability to death'.[11] The Apostle Paul states this unmistakeably in Romans 5:12:

> just as sin entered the world through one man, and death through sin, and in this way death came to all men, because all sinned ....

- that is, sin came into the world through Adam, and as a result death also came through him. We have it also in I Corinthians 15:21,22:

> For since death came through a man, the resurrection of the dead comes also through a man. For as in Adam all die, so in Christ will all be made alive.

The problem arises once it is accepted that human death is a consequence of the Fall. This is inescapably taught in Genesis 3, even if the narrative is not interpreted literally, but seen as symbolic and figurative.[12] If the first man was created unfallen, he must have been created free from physical death. We do not know what future would have awaited him had he remained unfallen. Perhaps after a long earthly life he would have been 'translated' direct to glory. We do not know. But he must have been created free from the curse of ageing and the openness to deadly disease and disaster which lie on every hand to a primitive man, sapiens, New Stone Age, or whatever. According to the evolutionary theory, Adam's body was the product of the process of evolution, and so was subject to death like the bodies of the beasts from which it had developed. Yet according to a central teaching of Scripture, originating in Genesis 3 read literally or otherwise and reiterated in the New Testament (and throughout Christian history), death is not natural to man: it is the result of his sin, and he must have started life[13] - as the bearer of the image of God - free from its curse.[14]

CONCLUSION

What, then, may we conclude? Is our Martian visitor right to see evolution and the Scriptural account as diametrically opposed? Or is it possible to reconcile the apparent differences into real harmony? We have taken two examples only, and in each case we have seen that, on examination, apparent discrepancies yield only still deeper real discrepancies. Not only is it true that the Genesis narrative reads as if it were intended to be taken at its face value. Even if it is not so taken - even if the days of Genesis 1 are seen as ages and the details of Genesis 2 and 3 as imaginative extras - still fundamental questions like the order of Creation in Genesis 1 and the nature of the Fall into sin and its curse of death in Genesis 3 compel us to conclude that harmony is not possible. The conclusion of common sense, and the conclusion of the outside observer, are confirmed by close examination. We may believe either the scientific theory of evolution, or the Biblical account of Creation. All the ingenuity of the harmonisers cannot reconcile the two except by emptying the one or the other of its distinctive features. Evolution is not a possible option for those who stake their faith on the authority of the Holy Scripture.

NOTES

1. E.K. Victor Pearce, Who Was Adam?, Paternoster, 1976, p 37.

2. A Hebrew and English Lexicon of the Old Testament, by Francis Brown, S.R. Driver and Charles A. Briggs, Oxford, 1906.

3. See J.G. McConville's article, Yōm - Day, in BC3, pp 85, 86, and comments in his review of D.A. Young's Creation and the Flood in BC1, pp 28-30. The fullest technical treatment is E.J. Young, Studies in Genesis One, Presbyterian and Reformed Publishing Company, 1976.

4. The first three days cannot, in any event, have been 'solar days', since there was, according to the account, no sun. E.J. Young himself allows of the possibility that 'day' could be employed 'figuratively' since 'it goes without saying that an historical narrative may contain figurative elements. Their presence, however, can only be determined by means of exegesis.' (Studies..., p 104.)

5. F.D. Kidner, Genesis: an introduction and commentary, Tyndale Press, 1967, p 55.

6. S.R. Driver, The Book of Genesis, Westminster Commentaries, Methuen, 1926, pp 20, 21.

7. Driver, p 25.

8. Driver, pp 25, 26.

9. Driver, p 26 (emphases his).

10. John Stott, Church of England Newspaper, June 7th, 1968; cited in Colin Chapman, Christianity on Trial, vol. 2, p 115.

11. N.P. Williams, The Ideas of the Fall and of Original Sin, Oxford, pp viii, 53.

12. This argument is developed further in the present writer's paper 'Evil and Evolution' in Focus on Creation, Rainbow Press, 18 Livingstone Road, Derby, 1978.

13. Whether as a baby, a man newly made from the dust, or an adult on whom has been suddenly stamped the image of God, does not affect the argument.

14. It is of little help to suggest that God might have specially intervened at this point, and changed the bodily constitution of the man concerned. The result would no longer be theistic evolution, but a form of special creation. And the magnitude of the changes required in the world that the evolutionists postulate is very great. Even though these changes may have been required for only a very short space of time, not only must the man's bodily functions be changed, for instance, to eliminate ageing, but the threats of wild beasts, disease, vulcanism, etc., must all be removed. If it is believed that all this indeed happened, the question must be asked: why should God choose to employ an age-long evolutionary process to reverse and abandon it at the crucial point? See the paper cited above for more discussion.